20th Anniversary Number

The Welding Engineer

Reg. U. S. Pat. Office

ume XXI January, 1936 Number 1

This number of The Welding Engineer, marking the 20th anniversary of its first issue, is dedicated to the memory of its founder, Mr. L. B. Mackenzie. On this occasion The Welding Engineer extends its thanks to all its friends for their encouragement and support by which it has been possible to carry on for these twenty years, and thus add its contribution to the advancement of the welding art. □ □ □ □ □ □ □

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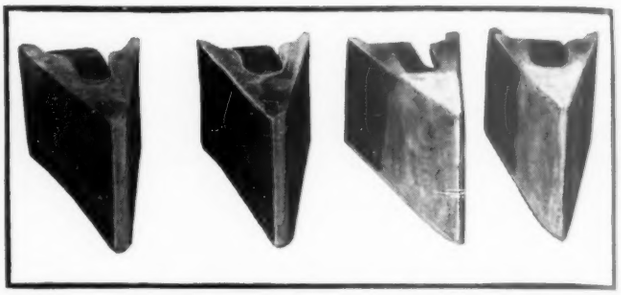
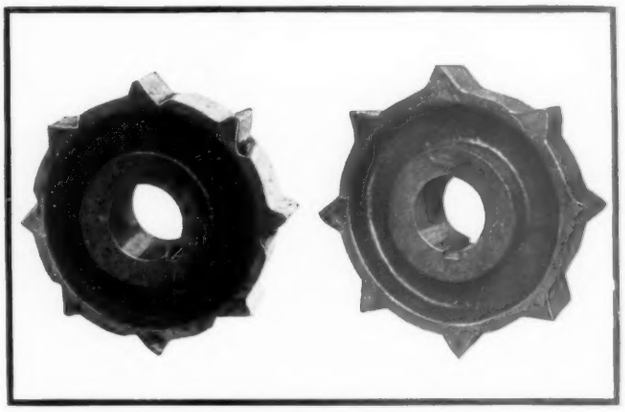
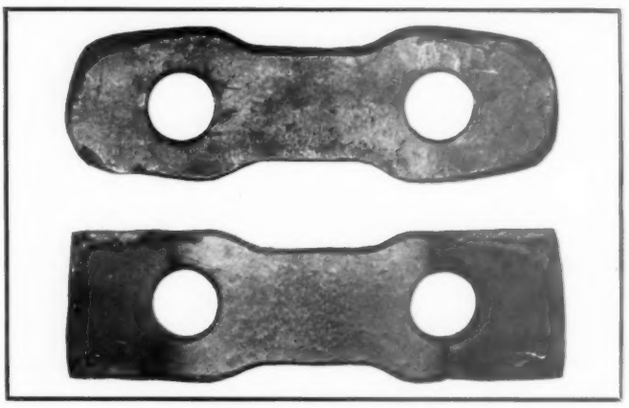


AMSCO Manganese Steel Dipper Teeth before and after hard surfacing with #459 Rod.



Carbon steel crawler sprocket wheel. Worn and as built up with AMSCO Nickel Manganese Steel Rod.



Above, a worn pulverizer hammer. Below, built up with AMSCO Manganese Steel Welding Rod.

AMSCO # 217 Welding Rod, a new hard-facing rod, differs from AMSCO # 459 in giving a much harder deposit, although one that is not quite so tough. Use # 217 for maximum abrasion resistance where no great impact is involved.

If you have never used the AMSCO Rods —send for free samples.

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THE WELDING ENGINEER

Vol. 21, No. 1 JANUARY, 1936

MAIN CONTENTS OF THIS ISSUE

STEEL BELT

Welding an 80-In. Steel Belt (Young) 27

ELECTRODES

Allocation of Electrodes to Various Types of Work (Muller) 30

METAL SPRAYING

Metal Spraying in the Welding Shop (Rice) 34

SPOT WELDING

Resistance Welding—I (Frost) 44

Editorial 23

L. B. Mackenzie 25

Iowa College Announces Conference Program 28

More Welding on Federal Inland-Waterway Projects 28

"Twenty Years Ago" 29

Program of Conference at Lubbock, Texas 32

Historical Data on Resistance-Welding Control 33

Portraits 43

Get "H. O. T." on Welding 48

What's New in Equipment and Supplies 49

Trade Literature 50

Commercial News 52

Notes From the Field 53

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A Featherweight Torch for High Speed Production and Sheet Metal Welding

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REGO DISTRIBUTORS IN ALL PRINCIPAL CITIES

Here's a torch that sets a new standard in welding economy—for with the REGO SX torch you can have the *same* economy of operation—the *same* savings in acetylene and oxygen—that make the REGO GX torch the standard of perfection in oxy-acetylene welding.

In addition to these features you will find the new SX torch is even lighter than the easy-to-handle GX. Its feather-weight control and balance will open your eyes to undreamed-of comfort in oxy-acetylene welding.

The REGO SX weighs only 13½ ounces, with a tip. It is this lightness that makes the SX ideal for high speed production welding. It's so easy to handle that speed of production is increased; the amount of welding per man-hour goes up; down go costs. For light welding and welding in tight spots the SX is balanced to make it fast-handling and easy to control.

Ask the REGO Distributor to show the new SX torch, or write. The Bastian-Blessing Co., 240 East Ontario Street, Chicago, Ill,

Pioneers in Equipment for Using and Controlling High-Pressure Gases.

INDEX TO ADVERTISERS

A

	Page
Adams Co., J. D.	55
Air Reduction Sales Co.	22
Aladdin Rod & Flux Mfg. Co.	64
American Agile Co.	60
American Arc Welders	62
American Brass Co.	51
American Manganese Steel Co.	Inside Front Cover
Anti-Borax Compound Co.	62
Arcos, Inc.	64

B

Barimar Limited	62
Bastian Blessing Co., The	6

C

Carter Hotel	62
Central Steel & Wire Co.	Inside Back Cover
Champion Rivet Co.	66
Chicago Steel & Wire Co.	64
Churchward Engineering Co.	Outside Back Cover
Colmonoy, Inc.	14
Commercial Acetylene Supply Co.	60

D

Duralloys, Inc.	57

E

Electro Cover Glass Co.	64
Equipment Manufacturing, Inc.	64

F

Faulk, F. R.	66
Fibre Metal Products Co.	58

G

General Electric Co.	12 and 13
General Welding and Equipment Co.	54

H

Handy & Harman	18
Harris Calorific Co.	10
Hobart Brothers	3
Hollup Corporation	20

I

Ideal Face Shield Co., The	58

L

Lincoln Electric Co., The	19

M

	Page
Machinery & Welder Corp.	55
Mallory & Co., Inc., P. R.	66
Maurath, Inc.	16
Metal & Thermit Corp.	15
Metal Bond Mfg. Co.	66
Milburn Co., The Alexander	64
Milwaukee School of Engineering	64
Modern Engineering Co.	63

N

National Carbide Sales Corp.	58
National Cylinder Gas Co.	17
New Process Plow Welding Co.	56 and 64

O

Owen Electric Mfg. Co.	60

P

Page Steel & Wire Co.	57
Phillips & Co., C. E.	65
Pierce Governor Co.	63

R

Revere Copper & Brass, Inc.	21
Roebling's Sons Co., John A.	4
Roth Welding Engineering Co., Inc.	58
Ryerson & Son, Inc., Jos. T.	53

S

Safety Gas Lighter Co.	24
Seneca Wire & Mfg. Co.	57
Shawinigan Products Co., The	66
Shoot-A-Lite Corp.	66
Steel Sales Corp.	59
Stoody Co.	Inside Back Cover
Stulz-Sickles Co.	65

T

Titan Metal Mfg. Co.	61
Torchweld Equipment Co.	59

U

U. S. Gauge Co.	61
U. S. Steel Corporation	11
United Welding Service	64

W

Weldit Acetylene Co.	56
Weldon Roberts Rubber Co.	60
Westinghouse Electric & Mfg. Co.	8 and 9
Wilson Welder & Metals Co., Inc.	7
Wooldridge Aluminum Welding Products	66

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Metal processing
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EDITORIAL

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Code of Ethics

● Following every period of recklessness and abandon, the pendulum swings back to renewed respect for old-tried principles and morals.

Today we find a growing interest in government that was not evident a few years back, and an increasing regard for constitutional principles and procedure.

So, it is apropos that we point out at this time the "Ethics of *The Welding Engineer*", appearing on the cover page of our first issue, dated January 1916:

1. To consider first the factor of safety. *The Welding Engineer* is unalterably opposed to the manufacture or sale of unsafe devices.
2. To consider and safeguard the interests of the subscriber.
3. To keep reading columns independent of advertising considerations and to measure all news by this standard: "Is it real news?"
4. To decline any advertisement which has a tendency to mislead or which does not conform to business integrity.
5. To solicit subscriptions and advertising solely upon the merits of the publication.
6. To supply advertisers with complete and reliable information regarding quality and character of circulation, including detailed circulation statements, subject to proper and authentic verification. *The Welding Engineer,* however, will not furnish or procure mailing lists for individuals or concerns for trade purposes.
7. To co-operate with all individuals and organizations in stimulating and extending the welding business.
8. To avoid unfair competition.
9. To determine what is the highest and largest function of the field and then to strive in every legitimate way to promote that function.

These clearly defined "first principles" established the standard by which *The Welding Engineer* has been guided through its twenty years. In the stress of times, it would have been very easy to flout them; temptation has been strong to interpret them loosely; competitive conditions have challenged them; times of adversity have tested them; a few friends of *The Welding Engineer,* lacking in understanding, have suggested that they be sabotaged.

But, after sober thought, we always go back to these "first principles".

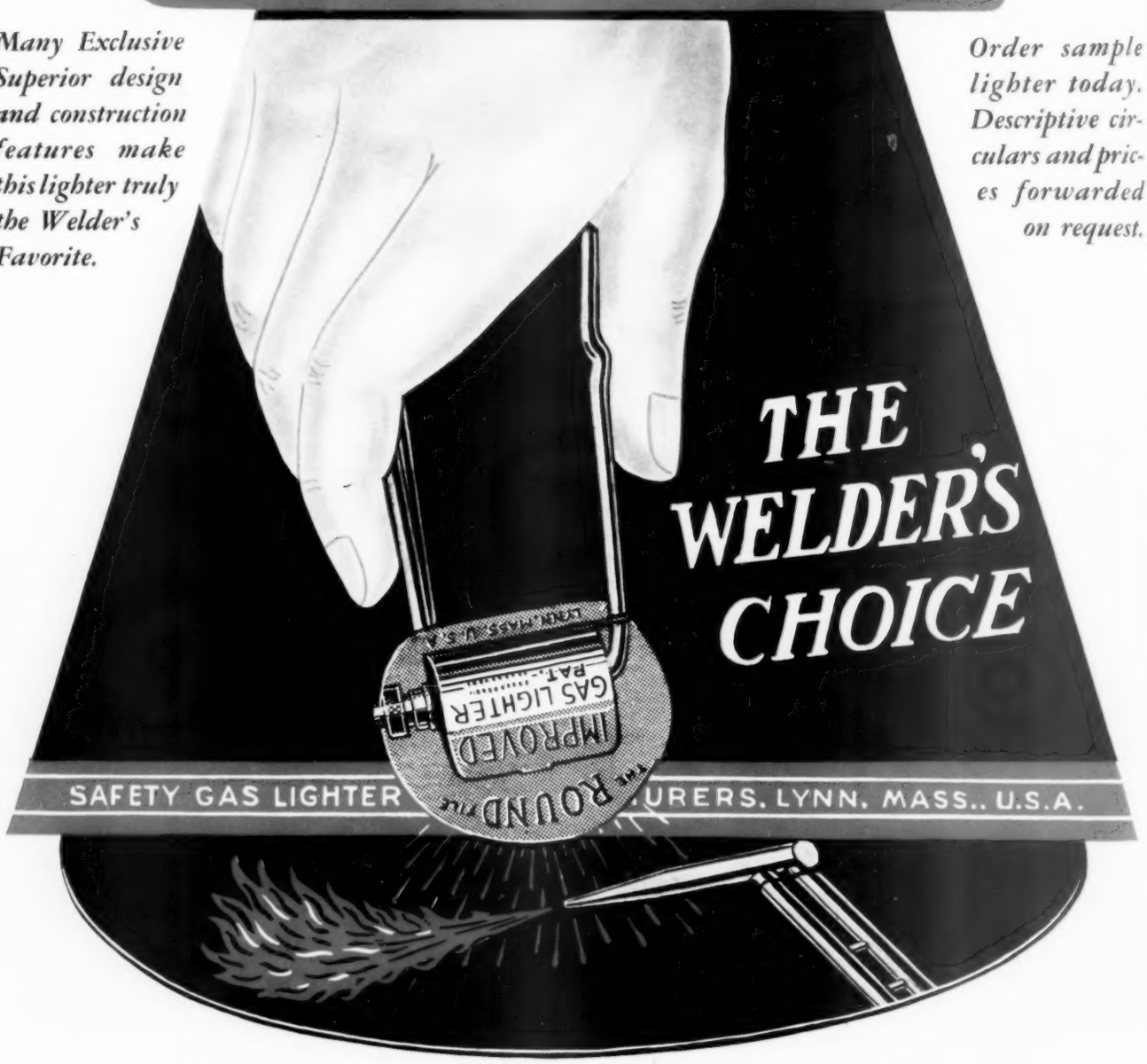
We believe that twenty years hence, they will still remain as fundamental as they are today and as they were in 1916.

Manufactured and Guaranteed by the Originators of the Hand Gas Lighters

THE IMPROVED "ROUND FILE" GAS LIGHTER

Many Exclusive Superior design and construction features make this lighter truly the Welder's Favorite.

Order sample lighter today. Descriptive circulars and prices forwarded on request.



Hood forms a pocket for gas, insuring immediate ignition.
Larger file area, providing longer life for lighter.
Larger spark metal, which assures many additional ignitions.
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SAFETY GAS LIGHTER CO. Established in 1901 LYNN, MASS.

L. B. Mackenzie

ABOUT July—1915—on what could then be termed the frontier of another great American industry, there stood a man with rare foresight and great courage. This man was L. B. Mackenzie and the industry was welding.

Although it took the Great War to show the possibilities of welding, nevertheless, the threshold revealed that welding had not advanced much beyond the stage where it was used for repair work, and while the oxyacetylene method was rather well established the electric-arc process was practically just beginning.

Mr. Mackenzie foresaw that welding would become a widespread art and that there would be a need for specially trained men, both technical and practical. He also saw that some medium would have to be employed through which the knowledge of technical men could be translated into practical form and then passed on to the industrial world. Mr. Mackenzie had considerable previous knowledge and experience in the publication field, and knowing the value of the dissemination of practical ideas, he conceived this magazine, which he christened "The Welding Engineer." That his judgment was correct was soon proven, because "The Welding Engineer" became popular almost with its first issue.

It was his desire to have "The Welding Engineer" spread the gospel of all methods of welding and the need for engineering study of these methods rather than any hit-or-miss practices of those not properly trained who knew little or nothing regarding the fundamentals.

To prove his contentions, "Mac," as he was affectionately known, offered prizes for the best-made welds. His office soon thereafter, and for a long period, looked more like a scrap yard than a business office. Tons of welded specimens with full description of how they were made poured into his office, and he delivered these specimens to a laboratory for the usual physical tests, and many a headache and heartache as well as joy were brought about when the results of many of these specimens became known to those who claimed to be experts.

This is but one of the many endeavors that "Mac" made to stimulate the art of welding. He encouraged the gathering of welding operators to discuss their problems, and fostered welding schools. Space does not permit the accounting of the many channels through which he played no small part in elevating welding to a higher standard.

He devoted all his time to this work, and his efforts seemed untiring. "Mac" at the time of his death could easily count his friends by the hundreds, and he built a monument which stands today as a credit to himself and to the Welding Industry.

—C. A. McCUNE,
Secretary, Magnaflux Corp.

Mr. L. B. Mackenzie

1880—1924

Founder of The Welding Engineer

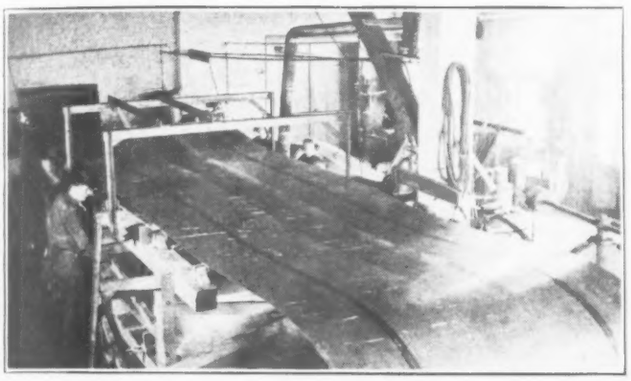
To whom this 20th anniversary number is dedicated

The Welding Engineer

VOLUME XXI JANUARY, 1936 NUMBER 1

Welding an 80-Inch Steel Belt

■ By HENRY W. YOUNG



The High Spots Were Marked With Chalk and Taken Out and the Belt Smoothed by Hand.

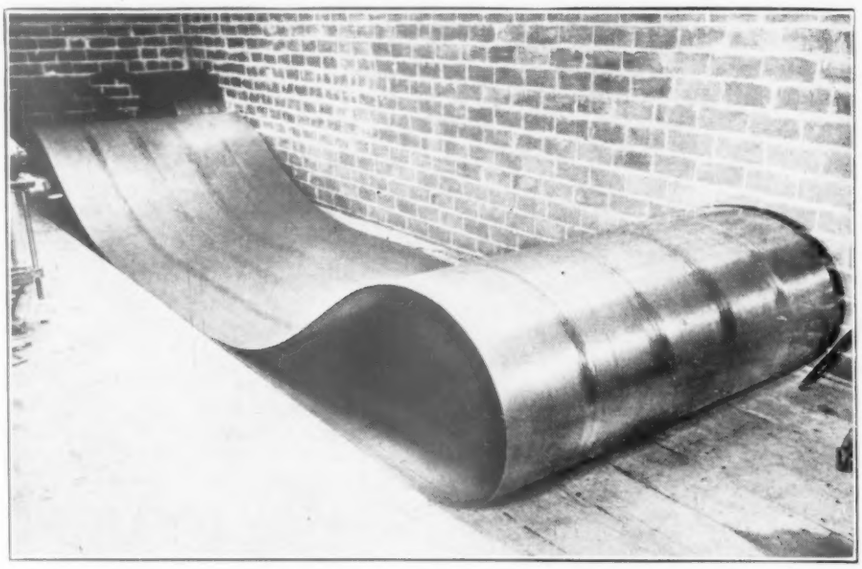
TO WELDING must be credited a great many "firsts" in all kinds of industrial applications. By no means the least interesting and important of these is the first welded steel belt ever made, as shown in the accompanying photographs. Its destination, and even its application, is for the present a carefully guarded secret, the user not wishing to have its application known before it is operating. It seems doubtful that it can be for power transmission or even for material conveying. A guess would place it as a part of some kind of heavy equipment.

The belt was made in the shops of O. J. Lougheed & Son, Inc., Portland, Ore., and shipped just before the first of the New Year. It was made of tempered, high-carbon steel of Rockwell hardness of approximately 44, having a tensile strength of 190,000 lb. per sq. in. It is 80 in. wide and 51 ft. long over all. The thickness is 0.072 in. In this application, whatever it is, no other material would withstand the stress, and the specifications called for a total capacity or pull of 600,000 lb.

As will be noted in the illustrations, the belt is made of five 16-in. strips of steel welded edge to edge. This work was done in a special clamping machine developed by O. J. Lougheed. Here, again, it is not permissible to be too explicit. In general, it may be said that the belt was run through the machine once for each longitudinal weld, in a horizontal position, the adjoining edges of the strips being butt welded with an oxyacetylene torch. This was followed immediately by peening with a small pneumatic hammer while the metal was still hed hot. Gas welding is used because it brings up the heat slowly, which is dissipated over a large area.

Small steel belts have been used before for power transmission purposes, particularly in Germany and Sweden, but they have been very small and not welded. In taking such a radical step as building a welded belt of this size, how did the prospective user come to locate a manufacturer away out on the Pacific Coast to tackle the job? Apparently, it was a case of looking for the proverbial "builder of a better mouse trap." The trail led to Lougheed's door, for he has been doing practically the same kind of work on large band saws for three or four years past.

Being located in the country of great saw mills, he conceived the idea of rebuilding band saws, many of which are from 40 to 50 ft. in total length,



51-Ft. Steel Belt Ready for Shipment.

20th ANNIVERSARY—1916-1936

WHAT electric welding has done for industry is best evidenced by the rapid growth in the sale of electric-welding equipment. In the six years from 1923 to 1929, this business doubled, and it again doubled over the six years from 1929 to 1935.

The reason for this outstanding growth is best seen when we analyze the advantages of arc welding as a means of fabricating metal. On large and small jobs, in every industry, lower costs, as well as distinctly better results, have been obtained.

As a pioneer in arc-welding development, the Westinghouse Company has contributed outstanding improvements from time to time, and the New FlexArc Welder, just announced by this Company, stands as an example.

We heartily congratulate you in celebrating your twentieth anniversary, covering, as it does, the active period of commercial electric welding. Our good wishes may be particularly appropriate at this time, since the Westinghouse Electric and Manufacturing Company this year celebrates its Fiftieth Anniversary of service.

—A. W. ROBERTSON,
Chairman of the Board,
Westinghouse Electric & Manufacturing Co.

* * *

IT DOES not seem twenty years since I talked, for the first time, with the founder of "The Welding Engineer," Mr. L. B. Mackenzie, prior to his first issue.

It is fitting that the twentieth anniversary number should be dedicated to him, whose vision of the possibilities in the field of welding and flame-cutting, and whose hard work and pleasing personality played such an important part in establishing the prestige of his paper.

Although the oxyacetylene process of welding and cutting was about ten years old in this country when "The Welding Engineer" was established, the improvement in the art in those twenty years has been remarkable, and unquestionably "The Welding Engineer" has played a decided part in this improvement.

—M. KEITH DUNHAM,
National Cylinder Gas Co.

* * *

THE WELDING ENGINEER is to be congratulated on the twenty years of courageous service it has rendered to the processes of joining metals by welding. Yours has been a task of holding aloft the beacon that has shed a kindly guiding and guarding light of technical and practical idealism throughout the hectic pioneer years.

That the Welding Art has grown from childhood through puberty and is now approaching manhood with a sane and normal outlook is due in no small measure to the excellent work "The Welding Engineer" has done.

"Just as the twig is bent, the tree's inclined." Universal Arc Welders salute you!

—A. LESLIE PFEIL,
President, Universal Power Corp.

IT IS certainly with pleasure that I note that "The Welding Engineer" will mark their 20th anniversary with the January issue.

The writer received one of your first issues some twenty years ago, and I want to compliment you on the help you have given the welding industry at large.

Twenty years ago it took a man of vision to realize the possibilities behind the oxyacetylene and electric-welding processes. Built up from a very small, struggling industry, today it holds a commanding position in the industrial field. Many industries could not have progressed so well as they have, had it not been for welding.

I certainly want again to compliment your good paper for the part it has played in building up this large industry.

—L. O. SCHNEIDERWIND,
President, Omaha Welding Co.

* * *

YOU and all of those who have been instrumental in the success of "The Welding Engineer" should be congratulated on the 20th anniversary of its founding and thanked for rendering a most useful service to the industry. Your paper has ably filled its particular field and contributed to the great advance that has been made in the welding art. Wishing you continued prosperity for many years to come.

—D. S. JACOBUS,
The Babcock & Wilcox Co.

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and a foot or more wide. Repeated filing of the teeth (it is still called filing although done wholly by automatic grinding wheels) eventually reduces the width of the saw until it will no longer run without the teeth coming in contact with the drive. Formerly, the saw had then to be scrapped.

Then Lougheed devised this welding and forging machine, so as to weld strips of steel to the plain edge of the saw opposite the teeth. He thus could bring the saw back to its original width and it could be continued in use. He rebuilds a saw at about half the cost of a new one, and it will be as good as new.

So Mr. Lougheed built up a reputation almost before he realized it, and when this great steel belt had to be made, someone evidently began scouting around to find out who could weld strips of steel together in this particular way, and the trail was finally followed to the door of the obscure "saw doctor."

Iowa College Announces Conference Program

The program of the eighth annual welding conference to be held at Iowa State College, Ames, Iowa, Jan. 22nd to 24th, has been announced by D. C. Faber, director, Engineering Extension Service, as follows:

Wednesday, Jan. 22nd

8:00 a. m. Registration, Room 105, Engineering Hall.
9:00 a. m. Exhibits and Demonstrations, Aeronautical Lab.
1:00 p. m. Opening Session, Room 207, Engineering Hall, in charge of W. L. Allan, Mayor of Ames.
"Welding Castings Without Preheating," by J. C. Menzies, C. E. Phillips & Co.
"Recent Developments in Low-Temperature Brazing," by A. W. Swift, Handy & Harman.
"Some of the Shop Welder's Problems," by A. R. Gustafson, Moline Welding Shop.
Round Table—"Welding Steel and Cast-Iron Boilers." Leader, L. C. Bitcon, Furlong Boiler Works.
"The Age of Speed," motion picture on grinding wheels, Courtesy of The Norton Co.
4:00 p. m. Demonstrations, Aeronautical Lab.

Thursday, Jan. 23rd

9:00 a. m. Demonstrations, Aeronautical Lab.
1:00 p. m. Session, Room 207, Engineering Hall.
"The Permanence of Oxyacetylene Welding," by F. C. Hutchinson, The Linde Air Products Co.
"Copper and Copper Alloys and Welding," by W. C. Swift, The American Brass Co.
"Hard-Facing Farm Implements," by Charles Nelson, Hamburg, Iowa.
"The Electric Arc," illustrated by motion pictures, by W. M. B. Brady, General Electric Co.
4:00 p. m. Demonstrations, Aeronautical Lab.
6:30 p. m. Welders' Banquet, Direction of W. L. Allan.

Friday, Jan. 24th

9:00 a. m. Session, Room 207, Engineering Hall.
Motion Pictures, "Welding the Upper Carnegie Building," by courtesy of The Lincoln Electric Co.
"Minimizing Distortion in Welding Light-Gauge Steel," by W. J. Carle, Air Reduction Sales Co.
"Arc Welding as a Fabrication Tool," by R. Notvest, J. D. Adams Co.
"Economy and Quality in Welding Through Personnel Training," by L. C. Monroe, *The Welding Engineer*.
1:00 p. m. Demonstrations, Aeronautical Lab.

More Welding on Federal Inland-Waterway Projects

The Federal Government is employing considerable welded construction in the vast number of inland-waterway projects in process at the present time, reports Charles Wellons, principal civilian engineer in the United States Engineers office at Pittsburgh, Pa. Mr. Wellons is an enthusiastic advocate for many uses of welding.

Although the government has not, as yet, compiled factual cost data on the merits of welded versus riveted construction, Mr. Wellons indicated in an interview with the Pittsburgh representative for *The Welding Engineer* that such data may be available within a year or two.

Recent contracts let by the engineer's office in the Pittsburgh district indicate that the government leans toward welded construction, not only because, in most instances, bids were lower, but more particularly on account of the fact that welded construction is being specified more generally on contemplated projects. For example, the government recently let a contract for four welded dump scows to the Ingalls Iron Works, and specifications are now being drawn for two more welded scows, of a different type, for use in the Louisville district.

"We have a lot of welded patch work done," said Mr. Wellons, "and this works out very satisfactorily. We have also been using welded construction on machinery bases for gate hoists on river locks and dams, which might have been riveted or cast. In the case of an engine base there is a lot of vibration, which tends to loosen riveted construction. Welded construction, of the same strength, is also considerably lighter than a cast or riveted job.

"We have had some large 8x10-ft. welded butterfly lock valves built for Dams 2, 3 and 9 on the Allegheny River. These have worked out satisfactorily. We are also making considerable repairs, by welding, at the government boat yards on the Monongahela River, near West Monessen, Pa.; this is for work which is not convenient to put out on contract, and includes repairs to lock parts, gates, valves and miscellaneous equipment.

"Another interesting use of welding is in connection with stainless steel, which, because of its resistance to corrosion, is being welded to structural parts where corrosion is likely to develop on

20th ANNIVERSARY—1916-1936

THE WELDING ENGINEER has been for twenty years and is today a guiding and inspiring medium for student and graduate welders. This school has always used "The Welding Encyclopedia" as its textbook and awaits with interest the monthly publication of "The Welding Engineer" for the latest developments in the industry. We wish to congratulate "The Welding Engineer" on the completion of twenty years of service to the welding industry.

—E. T. SCOTT,
President,
Cleveland School of Welding, Inc.

* * *

WELDING in the United States is years ahead of that in any other country in the world. Welding is not only done faster and cheaper but in general is done very much better. The selling price of the equipment and electrodes is also a fraction of that in any other country in the world. The use of welding also is very much larger, as would be expected from this record. Probably a good deal more than half of all the welding done in the world is being done in the United States.

The redesign from castings to welded steel has been the major item in this application; and while there are countless other cases where this application is being made, yet this is and will continue to be for some time to come the chief application. In carrying this out to the best advantage, new steel shapes should be developed by the steel mills. All the shapes at the present time were made that way because they were adapted to riveting, but since riveting is becoming less important and will within a comparatively short time entirely disappear, the steel mills should restudy this question and develop the shapes which will best use steel, for use in the applications where welding is being applied. Certainly an I-beam, an angle and a channel are very seldom the best shapes that can be developed for resisting bending or buckling in the usual construction. New thought along this line will enormously increase the steel market, will enormously increase welding and will very greatly decrease the manufacturer's cost of manufacture.

It is in this direction that re-employment must come—not from alphabetical monstrosities.

—J. F. LINCOLN,
President, The Lincoln Electric Co.

* * *

IT IS with great pleasure that I have learned that the January, 1936, issue marks the 20th anniversary of the founding of "The Welding Engineer." In this anniversary number I wish to pay tribute to the founder, Mr. L. B. Mackenzie, who had the keen vision and foresight to publish the first engineering magazine in this country devoted exclusively to welding and embracing all processes. It has been a pleasure to note that "The Welding Engineer" has kept apace with the industry. I wish it continued success and trust that it may always preserve the ideals of its founder.

—W. SPARAGEN,
Technical Secretary,
American Welding Society.

* * *

DURING the past 20 years welding developments have contributed much toward industrial progress, making possible numerous improvements resulting in new and better products and decreased cost.

There is no doubt that "The Welding Engineer" has provided much valuable practical and technical information, along with interesting welding news; all of which has contributed to the advances that welding has made and is continuing to make.

Your magazine is easy to read, the editorials are interesting, and its contents are always worth reading. Ship and barge welding, and shrinkage articles have been particularly interesting, along with other data related to shipbuilding welding, including welding materials and equipment information.

May your progress continue with even greater success during the next 20 years.

—G. H. MOORE, JR.,
Newport News Shipbuilding
& Dry Dock Company.

account of moisture. We are using stainless-steel rods for the weld but do not know, as yet, if it will hold up. We will, however, know this in a year or two from studies made at the boat yard.

"We are welding railings and sockets on various dams to keep persons from falling into the water, and this type of construction is working out very well. We are also using welded construction in many places where we formerly used steel castings. In general, we use welded construction wherever it appears to be more economical than other methods."

Mr. Wellons pointed out that W. E. Sidney, senior engineer in charge of the design division in the Pittsburgh office, is also a welding advocate.

Other instances of government welded construction were in connection with rudders for a tow boat, made of double-skin plates, which had the appearance of one piece of metal and a perfectly smooth exterior surface which set up practically no water resistance; also a welded base for a stand-by power unit, including a gasoline engine, electric generator and pump. The welded base was approximately 15 ft. in length. Another item included a welded hoist frame for the new Savannah Bluff lock and dam job on the Savannah River.

Twenty Years Ago

From the files of The Welding Engineer, January, 1916.

"Today the railroads are saving a million dollars each year by the aid of welding apparatus. . . . We know of a Western road which in 1914 effected a saving of more than a quarter of a million dollars through the reclamation of broken and scrapped machines, parts and equipment."—From an editorial.

* * *

"Economy in Gas Cutting," an article by J. F. Springer, discusses the theory of cutting and gives some fundamental data. Oxy-hydrogen cutting is discussed at some length in another article, by H. J. Mueller.

* * *

The Philadelphia Suburban Gas & Electric Co., at Chester, Pa., is reported as having been using oxyacetylene welding in their pipelines for four and a half years. "We are not only saving money by welding," J. D. Shattuck, general manager, is quoted as saying, "but we are getting tight lines."

* * *

Results of experiments conducted by the Pullman Co. are cited as showing the advantages of employing two operators to weld simultaneously on both sides of the work. Where cutting out is required, less material need be cut away and, of course, not so much metal is necessary to fill in the joint. With the weld made on one side only, a 5/32-in. electrode, using 120 amperes, proceeded at a rate of 1¼ ft. per hour, or 5.5 kw.-hours per foot. Welding on both sides simultaneously, an electrode of the same size with the same current progressed at the rate of a foot in 10 minutes, or 6 ft. per hour on a single groove, or 3 ft. per hour on a double groove, or at the rate of 1.2 kw.-hours per foot. With oxyacetylene welding of heavy steel pressure tanks, a saving was made by welding both sides of the seam at one time, and an inspection of the weld revealed a "closer union of the fibers and less flaws." The explanation here was said to lie in the reduced heat necessary to bring the metal to the welding heat, and the fact that team work demanded that the two operators work more steadily, so that one may not lag behind.

* * *

The advantages of welding high-speed steel to mild steel were being promoted in an advertisement of The Toledo Electric Welder Co. "$3.00 per pound is paid for high-speed tool steel and the small pieces thrown away, when it can be saved down to the last stub end by electric welding it to low-carbon steel," says the ad. An editorial touches on the same point.

* * *

In the oxyacetylene welding of hand trucks, by the Standard Improved Truck Co., of Chicago, it is reported that "welding not only produces a one-piece truck with an efficiency of the welds 482% greater than a riveted joint, but has increased the output per man about 20% with a saving of over 30% of the previous cost of manufacture per truck," and a Robert W. Hunt & Co. report is reproduced as proof.

* * *

When 1,200 2¼-in. tubes for condensers for a benzol plant were, through an error, cut 2 ft. short, the oxyacetylene welding torch was brought into play to correct the error, so the job could be delivered within contract time.

Allocation of Electrodes to Various Types of Work . . .

(Paper presented at the Purdue Welding Conference, Lafayette, Ind., Dec. 5-6, 1935.)

■ By JULES MULLER
Consulting Engineer,
Chicago Steel & Wire Co.

WELDING and its applications is a subject often discussed with respect to individual preferences. We find available many types and brands of electrodes as well as many types and makes of machines from which we may choose. Our purpose, however, is to select the most economical type of electrode for the given job.

It is well for us to consider the present trend of the welding industry and to analyze available statistics. Some shops prefer to use one type of electrode only, whereas other shops will use various types depending upon the nature of the work to be welded.

The available electrodes are generally classified as:

(A) Bare wire
(B) Dust coated
(C) Standard coating
(D) Heavily coated
(E) Automatic wire
(F) Alloy steels (above 0.18 C)
(G) Special wires
(H) Stainless steels

An appropriate description of the various types of electrodes accepted for a statistical report is as follows:

(A) *Bare Electrode.*—A selected wire for electric-arc welding, in the condition, as to finish, in which the wire leaves the drawing blocks, whether bright or sulfinish; in coils or straight, and cut to desired lengths. It may be furnished annealed.

(B) *Dust Coated or Washed.*—A coated wire with a flux in the form of loose dust, regardless of means of application of the coating. Washed coatings and coatings otherwise applied are to be included in this classification, the processing under this classification being such as to reduce or eliminate the dusting of the flux coating.

(C) *Dipped Electrode.*—An electrode that is processed by dipping one or more times so as to secure a coating of such thickness that makes it necessary to provide a means of securing electrical contact. Heavily coated or "shielded-arc" electrodes as defined under classification "D" and stainless or non-ferrous alloy electrodes as defined under classification "H" are excepted from this classification.

(D) *Heavily Coated Electrodes.*—Electrodes with a coating which during welding produces an envelope over the molten metal sufficiently great as to exclude practically all oxides and nitrides. This coating may be applied by extrusion, wrapping or dipping.

(E) *Automatic Wire.*—A selected wire for electric welding as described under "A" or "B" but furnished in coils only.

(F) *Alloy Steels.*—An electrode of an iron alloy containing over 0.18% carbon, and ferrous alloy electrodes which deposit a weld metal containing more than 1.25% of any elements other than iron and carbon.

(G) *Special Wires.*—Electrodes which deposit a weld metal containing not more than 1¼% each of any element or elements other than iron or carbon shall not be classified as ferrous alloys, but as special wires.

(H) *Stainless Steels.*—Stainless steel under this code shall be considered as any steel containing more than 3% chromium.

The welding industry has been selected as one of the favored industries which are to enjoy an expansion during the period of business recovery. We must admit that we are a young industry and should therefore grow to maturity as rapidly as we can inspire confidence in our work. The available statistics show that we are growing very rapidly. For instance, we find that approximately 39,000,000 lb. of welding wire was used in 1933, 57,000,000 lb. in 1934, and 37,000,000 lb. during the first six months of 1935.

How much, or rather, what percentage of each grade or type of wire was used? The various percentages of each grade or type used are as follows:

Grade or Type	Percentage of Each Type Used (6 Months)		
	1933	1934	1935
A	26.7	20.3	15.3
B	15.2	14.9	12.0
C	14.2	7.8	5.9
D	32.6	47.7	57.7
E	5.2	3.3	4.0
F	3.4	3.2	2.1
G	2.5	2.1	2.2
H	.1	.7	.7

From the foregoing figures we conclude that the heavy-coated electrode is becoming a favorite and is very rapidly displacing type "C" electrodes.

The rigid requirements of our welding codes have been partially responsible for the increased use of heavy-coated electrodes. A large amount of the heavy-coated electrodes was used in the construction of our new cruisers. We cannot explain the increased use of heavy-coated electrodes without comparing the physical properties of the weld metal deposited with types A, B and C, on the one hand, and with the heavy-coated electrodes on the other. The ranges of physical properties of welds made with these electrodes are found to be:

	Types A, B, C	Heavy-Coated
Ultimate strength, lb. per sq. in.	45000-55000	65000-75000
Elongation in 2 in.	8% to 12%	18% to 35%
Fatigue endurance limit, lb. per sq. in.	16000-18000	26000-32000
Charpy impact, ft.-lb.	12 to 20	35 to 55

The range of physical properties given above can be narrowed by following rigid welding procedures. The physical properties which are insisted upon in the required tests for various welding applications are not always representative of the physical properties of the weld deposit in an actual structure.

Ductility Influenced by Temperature of Test Block While Welding

The percentage elongation obtained from various tests varies somewhat with the temperature of the plate during the welding operation. If a ¼-in. electrode is used to weld up a ¾-in. test block, and if we allow the block to cool thoroughly to room temperature between each layer, the ductility obtained (measured in terms of percentage elongation in 2 in.) will be 18% or less. Should the block be allowed to cool to a minimum temperature of 250° F. between layers, the percentage elongation obtained will be well above 25% in 2 in. These results are disconcerting inasmuch as some structures are welded at room temperature. The prevailing standards and outlines of the method of testing do not elaborate sufficiently on the exact procedure to follow.

The ductility obtained in the weld deposit when the hot welding procedure is followed is very desirable. The heavy-plate-welding industry produce heavy structures which are welded more

20th ANNIVERSARY—1916-1936

THAT the art of welding has been practiced long enough to have justified the publication for 20 years of a periodical devoted to the interests of welding is evidence of the importance of that art.

Everyone who has been interested in the use of welding for any purpose whatsoever appreciates the great changes and progress that have been made in men, methods and materials in recent years.

It is largely through such mediums as "The Welding Engineer" that the record of accomplishments is distributed and made available to others, all of which is in the general interest of the art.

It is to be hoped that "The Welding Engineer" will continue to be indefinitely of service to the industry, as it has been in the past twenty years.

—E. R. FISH,
Hartford Steam Boiler
Inspection & Insurance Co.

* * *

MAY I add my greetings to those of your many friends on the occasion of the 20th anniversary of your splendid publication?

Certainly the progress made in welding in the last two score years cannot be equaled by that made in any other method of fabrication and I believe the progress in the next twenty years will far surpass that already made.

I have been one of the few persons privileged to see the results of a scientific development which bids well to revolutionize the welding art. I have not seen the apparatus nor the actual welding being done but the results are most revolutionary. I have seen 40-mesh wire screen, brass, steel and stainless, butt welded, each separate wire perfectly welded to its mating wire with no perceptible change in the diameter of the wires and the only indication of the resultant weld being a slight discoloration.

The principle, I am told by the inventor, is new and revolutionary. The equipment is no larger than an ordinary automobile battery and the current was supplied by a house lighting system. As explained to me, the principle is one of molecular vibration, during which the materials are brought together and perfectly bonded through the medium of a small electric current.

A representative of one of the largest producers of steel recently told me that his company had purchased the rights to the process for use in welding steel.

The possibilities of this development alone are staggering to the imagination. We have progressed during these last twenty years to the extent of making predictably satisfactory welds of excellent physical properties. I believe our progress in the future will be in the development of new methods of producing welds at but a fraction of the cost of those of today. This will result from independent research by scientists, such as accomplished the results referred to above. This gentleman is one of the world's outstanding authorities on light, and he attacked the problem of welding unhampered by knowledge of our present equipment.

"The Welding Engineer" has done a fine job of bringing to industry the developments of the art. My best wishes to you on your twentieth birthday.

—A. E. GIBSON,
Vice-President,
The Wellman Engineering Co.

* * *

CONGRATULATIONS to you on the celebration of your 20th anniversary!

I have watched with interest your magazine develop from the early days down to the present, as I have watched welding grow from the stage where a bundle of rusty ¼ in. Norway iron, 10 ft. long, and a roll of ⅛ in. brass spelter wire was a good stock of welding rods —and a few kegs of chlorate of potash was a good potential supply of oxygen.

Your magazine has helped make welding history.

—ELMER SMITH,
President,
Smith Welding Equipment Corp.

or less cold. The major part of the strains set up due to welding are removed through strain-relieving heat-treatment (low-temperature anneal). A portion of the highly desirable ductility developed in a hot weld is also imparted to the weld by the effect of the low-temperature-annealing cycle.

The mass of test data on heavy, multiple-layer welds indicate that each layer must not exceed a certain thickness if a refined structure in the weld deposit is to be obtained. The depth of the refining action of the arc depends on the type of electrode used, the current density, and the arc voltage. The types of slag produced through the action of the various coatings have probably a contributing effect; however, this effect is not yet thoroughly understood. The thickness of the deposited layer should not exceed the diameter of the electrode, nor exceed 5/16 in., whether a ⅜-in. or 7/16-in. electrode is used. The number of layers, or beads, required to complete a heavy weld varies somewhat if high welding currents and large electrodes are used, but never should the thickness of the individual layers exceed 5/16 in.

For Dynamically Loaded Structures, Use Heavy-Coated Electrodes

The use of bare-wire welds versus heavy-coated-electrode welds should be based upon economy and performance. Every designer, welding engineer and welding supervisor is vitally interested in producing a weld that will be entirely satisfactory at a minimum cost. Whenever a fabricated structure is to be subjected to repeated loading, we must provide a weld that has the necessary property to withstand that type of loading; therefore, we will select a heavy-coated electrode with which to do the welding. However, should the welded structure be required to withstand known loads of a static nature only, with very few or very small impacts, such as prevail in office buildings or hotels, we are justified in selecting a bare, dust-coated or light-coated electrode producing welds of the physical property given above.

The heavy-coated electrode will produce a weld of ultimate strength from 65,000 to 75,000 lb. per sq. in. and ductility of 20% to 35% elongation in 2 in. These electrodes should be used for work where repeated impact loads prevail, and especially where the structure, through its failure, is likely to endanger human lives. In other words, dynamically loaded structures should be welded with a heavy-coated electrode.

The physical requirements of welds for Class 1 pressure vessels are very clearly set forth in the A. S. M. E. Boiler Code. The methods of inspection set forth therein are so concise that there is no room for any alibis.

Economics of Welding Affected by Electrode Speed

There is considerable controversy as to the economic basis of welding. We know, and have records to show, that the high speed of the protected-arc electrodes generally offsets the increase in the cost of this material; however, in defining the economical field of application of the heavy-coated electrode, it is well to remember that on a few particular jobs the bare wire can produce more feet of welding than can be produced with the more expensive heavy-coated electrodes.

Ordinary welding of tanks for household oil storage, as well as small water tanks, can be done with automatic wire. These tanks are generally made in quantity; and special machinery suitably designed, permits the use of automatic wire, and reduces costs.

Making Machinable Welds in Cast Iron

Whenever we are confronted with welding unusual shapes of materials, especially cast iron, we look forward to an electrode which will produce a machinable weld. This feature has always been misunderstood. It is not difficult to produce a machinable weld on cast iron. If the theory of what takes place is understood, any electrode containing as high as 0.18% carbon can produce a machinable weld.

However, a very-low-carbon electrode, if misused, will produce a hard and brittle weld. We find that the individual making the weld can produce a sound weld that is machinable or is not, but in every case, whether the weld is machinable or not, the chief difficulty is in a zone a short distance away from the line of fusion, which is extremely hard to machine. That is due to the heat gradient set up in the cast iron. The prevailing temperatures and duration of these temperatures permit the chemical constituents of cast iron to change in form from graphitic carbon and free ferrite to cementite.

Preheating Required for Metals of High Thermal Conductivity

The question of welding bronzes and brasses electrically has been brought up several times; and inasmuch as most of those materials are used for uniting cast-iron sections, the oxy-acetylene flame is considered more adequate for

20th ANNIVERSARY—1916-1936

IT DOESN'T seem possible that twenty years have passed since we, as an industry, began giving consideration to this new method of fabricating structural steel and building machine-tool parts, and yet, when we recall our early efforts and enumerate the various steps or experiences through which we have passed together with the industry in its progress, it seems that this period is scarcely long enough to permit of the attainment of the high levels already reached.

Our original efforts at welding in the structural shops were confined to the attachment of base plates to columns and fastening anchor bars to various types of members which were to be cast in concrete, etc.—all items of manufacture wherein consideration of the factor of strength was (fortunately) not required, and progressed to the point of substituting welding for the conventional punching and riveting in the construction (both shop and field) of the Milwaukee Hospital Addition, which, at the time of its building, was the first welded building project of any consequence in this district and of which we felt justly proud.

Contrary to our expectations, however, the success of this venture and similar successes in other parts of the country have not lent the impetus to this class of construction we had hoped for, and although there may be no lack of interest in welding construction for buildings and bridges, we believe that a further education within our industry and extensive research in stress analysis is necessary before we can hope for general public acceptance of this class of welded work.

Greater economies in time and costs and, therefore, probably greater progress, have been made in the use and acceptance of welding in the manufacture of pressure vessels and machinery. In this general field the exchange of ideas and splendid cooperation of "The Welding Engineer" and kindred publications in offer ng open discussions of our problems has been, in no small degree, responsible for the notable progress made in recent years. An ever-increasing market is demanding better deliveries and more exacting workmanship, necessitating and actually assisting in the improvement of our industry by forcing closer study to the problems presented. These studies have necessitated the development of an entirely new type of engineering division wherein a knowledge of metals and their workability is as essential as a knowledge of computation of stresses and apportioning material to support given loads.

In early days a print showing the dimensions and thickness of material and general assembly of our customers' requirements would be sent to the shop to be put together and welded with whatever kind of rod was nearest at hand. We would view the finished product with pride, paying no attention to the waste in material, undercut welds and other deficiencies which have long since been corrected in our industry. Today our engineers seek information regarding the exact use the equipment will be put to and, from that point and the customer's general requirements, proceed with the design, selecting the metals best adapted for the purpose, and the type of rod, and dictating the sequence of shop operations, and often assisting in final check and inspection of the finished product.

In this connection it is fitting also to make some mention of the progress which has been made in the manual part of the job. The haphazard work (as viewed in the light of present-day efficiency) has been replaced by the performance of expert welders, specialists in joining the materials for particular products. Classification of welders by tests of their workmanship, certification of ability under various specifications and general pride in individual ability are adding to the score of the shopmen in keeping their development abreast of the progress made in the engineering departments.

We feel that worthy progress has been made in this still comparatively new industry and will no doubt find that in much less than 20 years hence the methods and scope of operations of today will seem as crude as the beginning which we look back on today.

—A. S. FREDRICKSON,
Lakeside Bridge & Steel Co.

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that purpose. However, the welding of copper or bronze sheet can be satisfactorily accomplished with the use of the electric arc, if the proper technic is followed. The high thermal conductivity of these materials necessitates preheating of the parent material prior to the beginning of welding. If such is not done, we have poor fusion between the weld metal and the parent metal until a suitable plate temperature is reached. A similar condition exists when welding aluminum, as aluminum is also a very good conductor of heat. Therefore, it behooves a welding supervisor and a welding designer to consider all these factors in order to produce an economical and sound weld.

Holds New York Meeting on Pressure-Piping Code

"Welding in the New Pressure-Piping Code" is the subject of a joint meeting of the New York Section, American Welding Society, and the Power Division, American Society of Mechanical Engineers, scheduled for Jan. 21st, at 8 p.m., in room 501, Engineering Societies Building, 29 West 39th St. The subject of "Steel Dams" will be considered at a meeting on Feb. 4th, called jointly by the local sections of the American Welding Society, American Society of Civil Engineers and American Water Works Association.

At the meeting to consider the pressure-piping code, Edwin B. Ricketts, chairman of the A.S.A. Code for Pressure Piping, will preside. A number of short addresses will be given by members of the Pressure-Piping Code Committee and others who have been identified with the formulation of this code, and a general discussion of the new code rules will be invited. Among the speakers will be A. W. Moulder, Grinnell Co.; A. M. Houser, Crane Co.; Alfred Iddles, United Engineers & Constructors, Inc.; and E. R. Fish, Hartford Steam Boiler Inspection & Insurance Co.

Program of Conference at Lubbock, Texas

Business is good in Texas, which is expected to result in a considerably increased attendance at the second annual welding conference to be held by the Texas Technological College, Lubbock, Texas, on Feb. 13th and 14th, according to J. C. Hardgrave, of the Department of Mechanical Engineering. The program is as follows:

Thursday, Feb. 13th

8:00 a. m. Registration in Engineering Building.
Chairman, Professor H. F. Godeke.
9:30 a. m. Address of Welcome, by Dr. Bradford Knapp, President Texas Technological College.
10:00 a. m. "Multiple-Flame Welding," by H. O. Green, The Linde Air Products Co.
10:50 a. m. "Economy and Quality in Welding Through Personnel Training," by L. C. Monroe, *The Welding Engineer*.
11:40 a. m. Photograph of group.
Chairman: (To be supplied)
1:00 p. m. "Identification of Metals To Be Welded." (Author to be supplied.)
1:40 p. m. Exhibits and demonstrations in mechanical engineering shop.
Chairman, Professor V. L. Doughtie.
7:30 p. m. "Welding of Farm Implements," by C. K. Rickel, Big Three Welding Equipment Co.
8:20 p. m. Motion picture, "Barrel Welding," showing welding of steel barrels.

Friday, Feb. 14th

Chairman, O. V. Adams, Dean of Engineering.
8:30 a. m. "Some Recent Developments in Silver Soldering and Brazing," by A. W. Swift, Handy & Harman.
9:20 a. m. "Hard Surfacing," by Don Llewellyn, Air Reduction Sales Co.
10:10 a. m. Motion picture. (To be selected later.)
10:40 a.m. "Welding in Plant Rehabilitation," by Robert Notvest, welding engineer, J. D. Adams Co.
11:30 a. m. Inspection of engineering buildings.
Chairman, L. D. Sugg, Magnolia Airco Gas Products Co.
1:00 p. m. "Seam and Spot Welding," by R. V. Van Kirk.
1:40 p. m. Exhibits and demonstrations in mechanical engineering shop.

Lays 140-Mile Gas-Welded Oil Pipeline

The Simrall Pipe Line Co.'s 140-mile pipeline from Crystal, Mich., to Toledo, Ohio, is nearing completion. This 8-in. line, being oxyacetylene Multi-Flame Lindewelded by the Franklin Tool Co., of Mt. Pleasant, Mich., will carry oil produced on the Roosevelt Oil Co. leases to the Standard Oil Refinery at Toledo. Two gangs have been engaged on the work, one starting at Crystal on Oct. 16th, working south, the other from the Michigan-Ohio state line, working north. The welding firing lines of these two gangs met at a point near Chelsea, Mich., on Dec. 12th. The laying gangs, on that date, were approximately 50 miles apart.

The operators on the firing line, in spite of bad weather and peat bogs, which frequently delayed the gangs, averaged better than 40 welds each per 8-hour day, the best day's work being 272 Lindewelds for six operators in 8 hours. This is the first line east of Chicago to be put in with this welding process.

On completion of this line, a 30-mile, 6-in. branch is to be Lindewelded, taking off from this line at Dundee, Mich., and running to the White Star Refinery near Detroit.

20th ANNIVERSARY—1916-1936

THE Twentieth Anniversary of the founding of your publication deserves wide-spread comment from those of us who have watched its growth literally from the beginning and realize how important it has been as a medium to spread widely the kaleidoscopic development of welding practically since its beginning. This art has developed so rapidly that methods thought to be good have become obsolete a year or so later and, yet, "The Welding Engineer" through its close contact with the American Welding Society and with the research and developments in the art of welding has gathered all this information, co-ordinated it and spread the knowledge widely among the actual users of welding.

In these twenty years, thermit welding, which in 1915 was a relatively crude process, has developed to become the standard method for the welding of heavy parts in steel-mill operation and practically standard for rail welding in street-railway practice and more recently in steam-railroad practice.

Electric welding has made phenomenal progress from the days of bare-wire welding, resulting in strong but brittle deposits with high oxygen and nitrogen contents, to the modern methods with coated electrodes with tensile strengths of 70,000 lb. to 100,000 lb. per sq. in. with corresponding ductilities in standard 0.505-in.-diameter specimens of all-weld metal of 35% and of 20% in 2 in. when these specimens are stress relieved at 1150° F.

The rapid strides in gas welding and flame cutting have been closely followed by your publication from the early days of the cumbersome oxygen and acetylene generators to the modern very important industries with their hundreds of strategically located generating stations serving industry with these welding and cutting gases in cylinders.

One wonders whether it will be possible in the next twenty years for the advance in welding to even approach that of the last twenty years; but whether or not this proves to be the case, it is definitely predictable that "The Welding Engineer" will follow this progress in detail.

—J. H. DEPPELER,
Metal & Thermit Corporation.

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DURING the past two decades have come the greatest developments in all branches of welding. Equipment, materials and processes have been improved and perfected. Applications have increased by the thousand. Welding, the interest of a few, has grown to be the industry of a multitude. Throughout these twenty years, these advancements in welding have been most ably chronicled in the pages of "The Welding Engineer." This service has been invaluable to the welding industry and it is hoped that this service will continue indefinitely.

Congratulations and best wishes.

—A. G. BISSELL,
Consulting Engineer.

Historical Data on Resistance-Welding Control

By H. W. ROTH
The Roth Welding Engineering Co., Inc.

Today resistance welding is "control" minded. The industry is quite familiar with such terms as "shot welding," "short-cycle welding," "synchronous timing" and others. But, little is known publicly about the history of welding controls. For a better understanding of this subject, a short historical review may be interesting.

The first spot-welding control, commercially used to some extent, was the "maximum" control, developed about 20 years ago, by Richard Mack, a German electrical engineer. It is based on the fact that a slight increase in amperage takes place as soon as the metal fuses between the spot-welding points. However, this is true only if a certain minimum of welding time is used, and a rather low welding pressure. The writer made extensive experiments with this type of control in 1919-21, and found that excellent welds would be obtained by increasing the pressure and setting the relay for as short a timing as possible. The result was neither uniform nor dependable, due to the variations in inrush current.

In 1921, a "straight" timing control was developed by the Peco Corporation, Munich, Germany, which, for the first time, made it possible to use a welding time as short as one cycle. A separate contactor was provided to close the welding circuit, while immediately afterward the automatic timer would open the circuit. This equipment was used by the writer for further experimenting with "short-cycle welding" in 1921. A double-turn secondary winding was provided to boost the voltage of an "old time" spot welder. With the pressure increased as much as the electrode tips would permit, and with the points fitted to a perfect contact with the metal surface, invisible welds were obtained on steel, brass, and aluminum. A number of spot welders of this type, installed in 1921, for the purpose of producing invisible welds on polished or nickel-plated sheets, are still in use.

To allow a further shortening of the welding time, the "straight timing" method lacked accuracy. Closing the welding circuit on any occasional point of the cycle would cause enough inaccuracy to result in a certain percentage of poor welds, especially in welding brass, aluminum, and stainless steel. Recognizing this fact, the writer started to experiment with synchronized timing, and in 1924 he developed a device for the controlling of spot welds in synchronism with the current wave. Then followed, two years later, the idea of using a synchronous motor for the operation of a mechanical welding contactor, especially for seam welding, with means to adjust the "break point" into the zero-line of the current wave, in order to eliminate arcing. Experts from a large electrical concern, invited to witness the experiments, called the thing a joke, saying "there is no use anyway for such a device in resistance welding." Today "short-cycle welding" is an outstanding production method in many industries.

For the purpose of welding ordinary steel sheets, a large variety of controls have been developed since 1925. The "maximum" method is still used by the German General Electric Company. "Straight timing" controls, designed as mechanical timers or tube timers, are common; another type, the so-called "current timer," developed in 1924, is of some value, wherever it is desirable to automatically take care of variations in metal thickness. It may be designed either as an electro-mechanical timer, or as a tube timer.

As a whole, the experience of the past 10 years has proved that progress in resistance welding depends largely upon "controls." But, as in many other fields of industry, the simplest is very often the best.

Automatic Welding Is Topic of Chicago Meeting

"Automatic Welding" will be the theme of the meeting of the Chicago Section, American Welding Society, to be held in Mission Hall, Armour Institute of Technology, 33rd and Federal Sts., on Friday evening, Jan. 24th. Speakers will explain and discuss the uses of automatic welding by the metallic-arc, carbon-arc and oxyacetylene processes. Jules Muller will conduct the usual course in metallography, starting at 7 o'clock. A dinner, in the same building, will precede the meeting.

The talk on metallic-arc welding will be given by A. M. Candy, consulting engineer, Hollup Corp. The other speakers are to be announced later. Albert Reichmann, vice-president, American Bridge Co., will preside.

The meeting on Feb. 28th will be devoted to "Welding and Cutting on Railroads," and on March 27th the subject will be "Making and Welding Stainless Steels and Nickel Alloys."

Welded Ship Sinks in Atlantic Storm

The *Joseph Medill*, a 259-ft. all-welded ship, constructed in England for service on the Great Lakes (see page 71 of the September, 1935, issue of *The Welding Engineer*) started on its maiden voyage to this country in August and was never heard from. There were terrific hurricane storms in its path, and apparently the ship sank with all on board. Scouting vessels sent to search for it report no wreckage found, and it is said the vessel carried no wireless. It is likely, say some, that the hatchway covers might have been carried away, enabling the seas to fill the ship. It seems to be the universal belief among men in the shipping trade that, whatever the cause, the welded construction was not at fault.

Metal Spraying in the Welding Shop . . .

■ By H. B. RICE
Metalspray Company

IN the United States metal spraying is about as old as welding, if by welding we mean the fusion and alloying of metals having melting points up to 3000° F., and by metal spraying we mean the commercial deposition of molten metals for practical and economical purposes, disregarding earlier laboratory and experimental claims. Welding has forged far ahead and is being used for important purposes in every large industry, and in volume of business is acquiring almost the status of a major industry.

Metal spraying had similar potential possibilities in many respects, but has realized but a small portion of the commercial importance of welding. This fact has often been critically commented upon, and the advocates of metal spraying have not always been able to answer these comments convincingly because of the obscure and sometimes ambiguous history of the development of spraying. Time creates perspective, is a splendid clarifier, and may provide the correct reason for such a disparity in growth. It has already given some good reasons for the phenomenal increase in the use of metal spraying during the past three or four years.

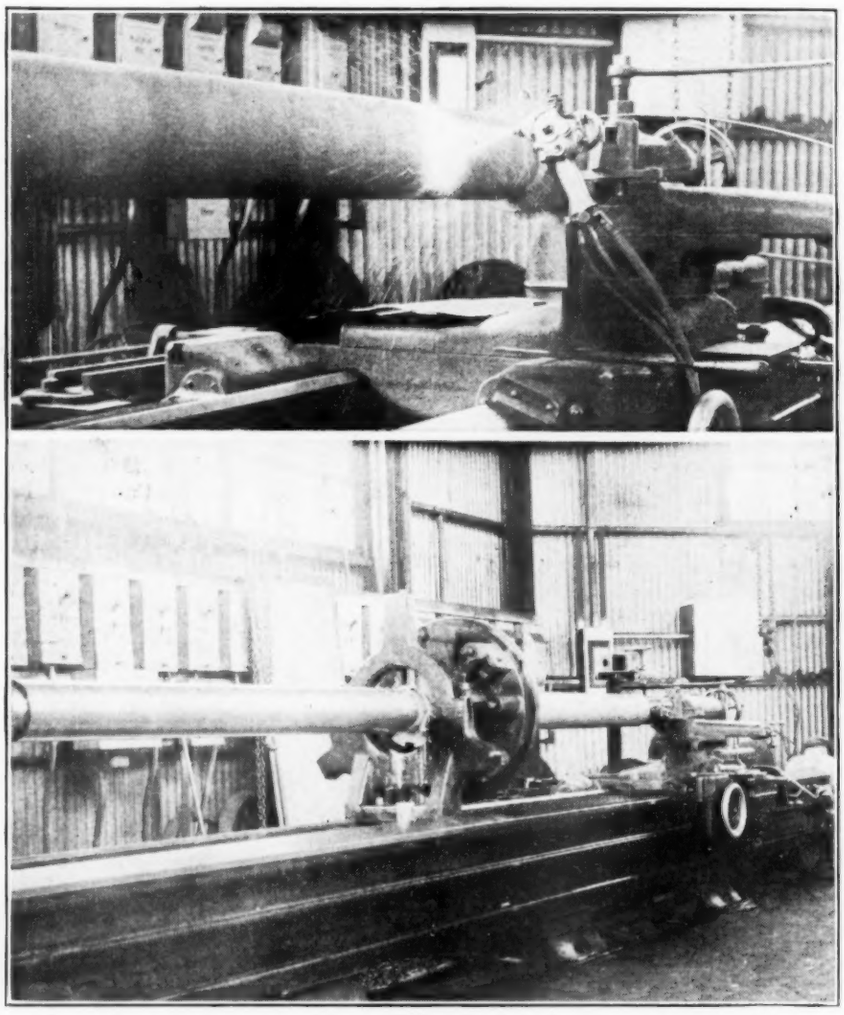

Fig. 1. Building Up Worn Corliss-Engine Piston Rod With Stainless Steel.

(This rod, 7½ in. in diameter and 18 ft. long, with a 60-in. stroke on each side of a 36-in.-diameter piston, was built up with stainless steel to eliminate corrosion. Upon checking in a lathe, the rod was found to be almost ⅛ in. out of line. Therefore, the entire rod area was machined true and a rough 20-pitch thread cut, 1/32 in. deep, was applied. One end of the rod was sand-blasted and sprayed in one working day and the procedure was duplicated to complete the other rod end the following day. Thirty square feet of area was sprayed 1/16 to ⅛ in. thick, and 141¾ lb. of ⅛x12-in. stainless-steel wire was applied with one gun in 19½ hours spraying time, using 1365 cu. ft. of oxygen and 1430 cu. ft. of acetylene, and air at 50 cu. ft. per minute and 60 lb. pressure. An allowance of 1/16 in. on the diameter was made for finish machining because of the size and exceptional length of the rod. The material and labor cost, except for machining, was less than $200.)

Very few processes adopted by American industries have shown rapid growth until the majority of the basic tools and materials necessary were manufactured in the United States. Although welding also originated in Europe and the earliest equipment was of foreign manufacture, there were several competent equipment manufacturers in this country prior to the World War. There is no doubt that the development of welding in this country is primarily to be credited to American methods and American manufacturers of improved equipment. If there had been no welding equipment of domestic manufacture available until three or four years ago, and the industry had been dependent upon foreign designs, would the welding industry in this country be where it is today?

Introduction of American Guns Stimulates Interest

This briefly has been the situation with respect to the metal-spray industry. Until very recently there were no guns available which were wholly of American manufacture and design, and only during the past five years have American manufacturers placed on the market a few types of metal-spray guns. Yet in this brief time there has been more business done, more interest created and more successful applications developed than in the entire American commercial history of the process prior to the World War. Foreign manufacturers have no doubt made a good product, but according to the record of business done recently, American industry prefers its own products. Fur-

20th ANNIVERSARY—1916-1936

IT IS well to pause and look back over the road just traveled and weigh the accomplishments. Much has been done to further the art of welding, and "The Welding Engineer" is to be complimented on the service rendered to the welding industry in the last twenty years.

In that time the welding art has progressed from a point where it was considered a doubtful substitute for older means of joining two or more pieces of metal, to that of an accepted means of fusing these same pieces into one solid unit of proven strength and durability. The present problem before the industry is not so much the perfection of welding practice as it is the application of welding to design and the fabrication of parts.

Many individuals and firms, due to lack of knowledge and to large investments in foundries and other equipment, hesitate to use the welding tool. This condition will exist until loss of business forces them to adopt welding as a more modern and economical method of fabrication.

In the future, specifications for the finished weld will be more exacting. Those people who have kept abreast of the developments in welding, will reap rewards in proportion to the extent to which this knowledge is applied. Common sense dictates that no one can sit idly by and watch the "other fellow" work and then expect to reap the benefits of his development.

—F. C. FANTZ,
Midwest Piping & Supply Co., Inc.

LET me congratulate you upon the anniversary of your journal. You know better than I do what difficulties you have had to combat. We both have been and still are pioneering in new fields. I therefore can fully appreciate your accomplishments and wish you lots of luck and success for the years to come.

Without underestimating the important role "The Welding Engineer" played during the past twenty years of welding history, it must be admitted that with our present-day knowledge of welding and the equipment which is available today, the art of welding could be practiced to a much greater extent. That this is not being done is surely not the fault of your publication. Just the contrary. Your efforts are in the correct place and are pointing the right way. It is the deplorable backwardness of a great majority of our American engineers; and to come right down to the root of the evil, it is the extremely poor manner in which welding is being taught at schools, colleges and universities today. An ordinary welder knows more about welding than the average college senior does. No wonder that responsible engineers do not feel inclined to apply a method they know so little about!

As far as the application of my pet method of non-destructive inspection of wells is concerned, this procedure has been practiced just about as long as your journal is in existence. It was during the World War that welded seams were examined by means of x-rays at the Woolwich Arsenal in England. In 1918 Dr. Ancel St. John became connected with the Union Carbide & Carbon Research Laboratories, where he developed a suitable technique for radiographing welds parallel to their scarfs. While this still is the best way to examine welded seams, it is only practiced in special research work, but is not required for routine inspection. Little work was done before we developed a technique and installed suitable equipment for routine inspection of welded pressure vessels. This work, which was done for The Babcock & Wilcox Co., is the basis of the radiographic requirements of the various boiler codes in use today.

While undoubtedly some progress has been made in the radiographic examination of welded structures, still a great deal more has to be accomplished before we feel satisfied. There still remain a great number of fields practically untouched where welding could be applied to a much greater extent if the seams were x-rayed. Only to mention a few, in building and bridge construction, aircraft industry, shipbuilding, heavy machinery and equipment.

You have done your share in promoting the art of x-ray inspection and have certainly been of valuable service to manufacturers of x-ray as well as of welding equipment. We, too, appreciate your cooperation and gladly take this opportunity to thank you.

—HERBERT R. ISENBURGER,
St. John X-Ray Service, Inc.

thermore, if the export of tools used in this process is a criterion, foreign markets admit the superiority of American-made metal-spray guns, for today imports are negligible and foreign markets have become an important outlet.

This situation has no doubt had an important bearing upon the disparity in comparable progress of the two processes, and will unquestionably permit of a more rapid development than has ever been experienced by welding. Although the present volume of business is but a small fraction of that of the welding industry it is confidently believed that it will soon compare favorably.

Some of the domestic metal-spraying devices are similar in design to foreign makes but involve refinements and improvements in operation, while others are distinct and unique and presage a broader development field.

Many excellent papers and articles on the subject of metal-spraying have recently been made available to engineering and industrial circles and it is therefore assumed that it is unnecessary to define or describe in detail the characteristics of the process or devices. Consequently, this presentation will deal mainly with recent developments.

Oxygen and acetylene are used almost exclusively to melt the metals; compressed air to atomize, convey and impact the molten metals and to propel an air turbine for power to move the metal into the flame. Any metal available in wire or rod form melting under 3000° F. may be readily sprayed with standard equipment. The improvement in devices during the past four years has been rather remarkable in many respects.

Aside from improvements in design and mechanical features, lower gas consumption and maintenance costs, the trend has been toward the use of larger-diameter wires and greater volumes of deposit. With steel and similar melting point metals of 16 and 18 gauge sizes, one pound deposit per hour was the average spraying capacity for years. Now standard units readily use steel in 14 gauge, 12 gauge, 9 gauge and 8 gauge, with deposits of 2, 3, 6 and 10 lb. per hour.

Good Deposits Can Be Obtained With Large-Size Wire

Early contentions were that the use of larger-size wire produced porous, non-dense deposits without merit or practical value. The subject was quite controversial but is rapidly arriving at a focal point of common agreement. No doubt early gun designs were unable to handle larger wires in commercial practices. Since improved design now permits the use of larger wire sizes, it has been found that density of deposits is not entirely in direct ratio to wire sizes used. The volume of air and gases used, their angle and direction of application to the spray wire, and pressure and velocity of impingement are all contributing factors to the density of deposit. It is also claimed, with some merit, that if the metal particles are fully molten and not plastic or semi-molten, when they impact, the resultant deposit, regardless of the degree of atomization, is dense and of good quality.

It is becoming increasingly evident that gun manufacturers must provide efficient tools to handle wire sizes ranging from 1/16 to ⅛ in. in diameter in

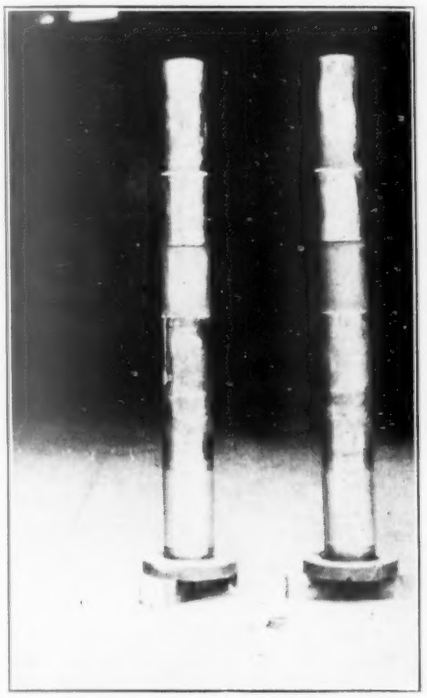

Fig. 2. Built-Up Corliss-Engine Valve Rods.

all of the ten or more present spray metals which have melting points ranging from 400° to 3000° F. Oxyacetylene welding has but two variables to contend with; metal spraying has four: oxygen, acetylene, air and wire speed, all centered in one nozzle. It is therefore obvious that a metal-spray gun is a far more difficult item to design and construct than a welding or cutting torch and that the development of the process is far more dependent upon the efficiency of the gun.

With further respect to wire sizes,

20th ANNIVERSARY—1916-1936

THE development of the science and art of welding during the past twenty years is not only enormous but constitutes about 90% of the total development from the early beginnings.

From the stage when welding was a mechanics' tool with very limited applications because of the abysmal ignorance of the scientific side of the subject on the part of most of those using the tool, we have come to a point where welding is an important branch of engineering, and I have often marveled at the foresight of the founder of your journal in giving it the title "The Welding Engineer."

In order to be a first-class welding engineer, one must not only know a good deal about metallurgy, chemistry, physics, including particularly electricity and magnetism, but in order to solve some of the most important problems of the present day, one must be an expert in applied mechanics, including the theory of elasticity and plasticity. In fact, there is no one field of engineering which requires as comprehensive a knowledge of so many branches of science.

I will not attempt even to mention the numerous fields of application in which welding has played so large a part during the period under consideration but will merely repeat what I have so often said during the past few years, namely, that in my opinion welding is the most important and widely used tool in industry today.

In this so rapid evolution it is only fair to say that "The Welding Engineer" has from the beginning played a very important part.

—C. A. ADAMS,
Harvard University.

* * *

CONGRATULATIONS on the twentieth anniversary of the founding of "The Welding Engineer." I congratulate you particularly upon your apparent editorial recognition of the fact that the various welding processes are really collaborators rather than competitors.

May the simultaneous progress of your interesting publication and the welding industry continue for many more scores of years.

—W. J. CHAFFEE,
The Hobart Brothers Co.

* * *

IN THE past seven years, during which I have been active in the welding business, the progress of welding has, to my mind, been far greater than during the fourteen years previous. The manufacturers of welding equipment and supplies are to be complimented on the fact that they are never entirely satisfied with their product, but are continually improving it to meet the demands of industry.

The many improvements which have been made within the last few years have resulted in the adoption of the process in practically every industry, and today welding is a necessity, whereas ten years ago it was more or less regarded as a last resort for making repairs.

Through the use of welding, manufacturers are today producing stronger machinery and steel structures at a lower cost. Maintenance and repair costs also are cut in half and many serious delays avoided.

Some companies have refused to accept the process, but if they were to read "The Welding Engineer" they would certainly realize what they are missing. I personally feel that your publication is doing excellent work in promoting the process and in assisting those in the business. Your articles cover all new developments in the field, and by reading it one can keep abreast of the times and acquire valuable knowledge which would only be otherwise obtained by expensive traveling.

Our company has followed these new developments as discussed in the articles, and as a result, has benefited materially.

You are certainly to be complimented for the service that you are rendering.

—R. J. McWATERS,
Manager, All-Weld Company, Limited.

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the majority of authorities now agree that the wide range of metal-spray applications requires a large range of wire sizes. For example, building up the worn surfaces of machine elements met with small success when small wire, small volume deposits, and consequent large costs per pound of metal deposited were the rule. The recent success and rapid increase in this type of application is directly attributed to the use of larger-diameter wires and greater deposit volumes. This paper will treat almost entirely with machine-element applications because this class of work more closely parallels the work of the average welding shop.

At this point it may be as well to make an observation based upon experience of long standing with both welding and metal spraying. Welding experience by no means insures a preferred status in learning the metal-spray business. Except that both methods use oxygen and acetylene, little similarity exists. Yet the welding industry should, and no doubt will, adopt this process, not only because of parallel applications but in view of the fact that they often complement each other. It is highly improbable that metal spraying will ever infringe upon or displace present oxyacetylene or electric-welding applications.

Mechanical Bond Produces Less Heat Than Fusion Bond

A welder's training dictates several firm rules: a minimum of oxidation and a maximum of fusion to obtain the highest degree of tensile strength. This major objective overshadows the fact that the area welded acquires a very high temperature while the adjacent areas are at normal temperatures. Years ago this was a serious limitation but methods were devised to neutralize many of the objectionable results. If metal spraying used a fusion bond its field would be materially reduced. It is not necessary nor desirable to increase the temperature of an object being sprayed over 100° above normal, and therein lies a distinction which clearly separates the two fields of application.

Experience acquired from welding will assist in many ways the process of metal spraying, but some of the hard and fast rules of welding must be disregarded if the merit of metal spraying is to be realized. A welder first viewing the spraying of steel is usually shocked by the apparent waste and oxidation which he assumed must occur in an exhibition resembling a large 4th of July sparkler.

Consideration must be given to the length of time the metal is molten, as well as other factors. Molten metal-spray particles travel at speeds said to approximate that of shotgun nozzle velocities. Almost instant solidification of the projected metal results upon its impact with the normal-temperatured surface. The metal is molten less than 1/100th of a second or about 1/1000th as long as with welding. Oxide inclusions, though greater than in weld metal, are not of major consequence, since tensile strength is not the most important requisite. Spray losses are largely due to failure of adhesion of a portion of the molten particles, but surfaces properly prepared for the reception of the sprayed deposit keep spray losses well within practical and economical limits; and with steel, for example, the losses need not exceed 10%.

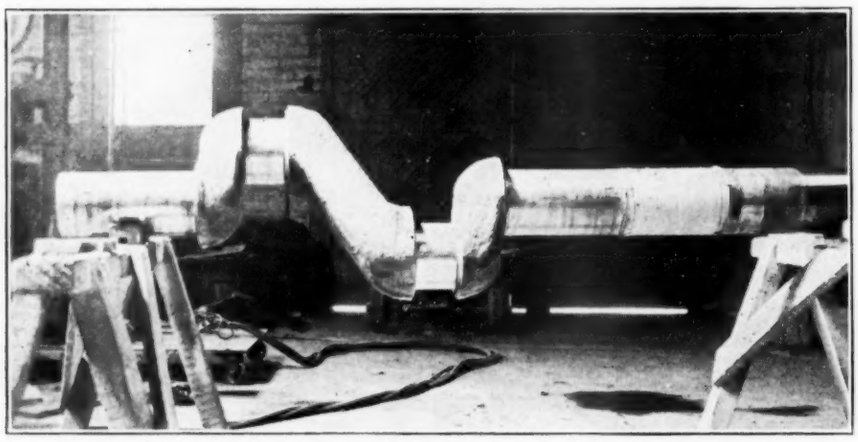

Fig. 3. Ice-Machine Crankshaft Built Up With Stainless Steel.
(A 6-in.-diameter section, 10 in. long, is built up ⅛ in. on the diameter, requiring 6½ lb. of ⅛-in. stainless-steel wire, 48 cu. ft. of oxygen, 56 cu. ft. of acetylene, 1¼ hours spraying labor and 1 hour to set up.)

Sprayed Corrosion-Resisting Metals Retain Their Passivity

Good weld metals usually lose their desirable qualities when sprayed, particularly hard-facing metals. This is not unusual, since such metals are specifically applicable to the welding process. Zinc, aluminum and stainless steel are some of the best spray metals, their

20th ANNIVERSARY—1916-1936

ON THIS your 20th Anniversary, I wish to take the opportunity of expressing my appreciation of the efforts expended by "The Welding Engineer" in its chosen field with respect to the advancement in the art of welding.

I have always felt that your publication has been very instrumental in presenting salient facts of interest both to the manufacturer and the user of welded pressure vessels, as well as to the engineers interested in the design and development of such vessels.

In the past, I have been very much impressed with the different articles appearing in your publication; in fact, have ordered many reprints of technical data.

Your policy in connection with presenting data should commend your publication as a most outstanding medium dedicated to the advancement and betterment of conditions in the welding industry.

—F. G. SHERBONDY,
The Biggs Boiler Works Company.

* * *

THE industry joins in appreciating the progressive helpfulness contributed by "The Welding Engineer" during the past two decades towards the advancement of the art of welding.

Many of us recall the untiring efforts of the founder and his associates in overcoming the difficulties encountered by the early commercial and industrial welders by seeking knowledge of methods and procedure throughout the world and passing same on to them for their guidance.

We can also recall, with no small degree of satisfaction, the positive prejudice registered against the process of welding by major interests that are now numbered among its most ardent advocates. Thousands of dollars were wasted on prejudicial propaganda which could have been better spent had they been applied towards open-minded investigation and research.

However, this is mostly history and, like the unwanted child that grew into successful adulthood and was then recognized by those that once offered only sneers, the process has reached to heights unsurpassing the hopes of its early pioneers and defenders, and it has been universally adopted.

The trend of welding progress is quite noticeable in the figures relative to consumption of weld rods. These show remarkable increases annually; and an interesting fact, that is not generally realized, is that the consumption of welding rods is rapidly nearing that of nails. To the visionary ones in the industry and allied industries this is important, and a picture of both past and future progress can be fashioned which will lead to heights now only faintly imagined. Pause a moment and realize what nails have contributed to the happiness and wealth of all mankind, and then check the figures of nails and welding rods. The two are not as far apart as one might think. They are, in point of usage, definitely related, and as man slowly learned to use nails and allied materials in greater annual quantities, so is he learning to use welding rods and allied materials in even greater annual quantities, and progress ahead is beyond the calculation of anyone.

For this progress we are greatly indebted to the pioneering done by many of our contemporaries and to the fortitude of the founder of "The Welding Engineer," for through this medium the rays of welding light were broadcast for the universal benefit of all men.

In conclusion, the welding industry congratulates "The Welding Engineer" on its twentieth anniversary and wishes it the utmost success for many future decades, and sincerely hopes the progress ahead will be shared to an even greater extent than that of the past as a fitting tribute to the man that gave his best in laying a sound and secure foundation for the process, by contributing information which led to great welding achievements.

—R. L. SCOLLARD,
Gulf States Steel Co.

deposits retaining almost fully their original corrosive-resisting characteristics, whereas problems still exist in the satisfactory welding of at least two of these metals. A striking irregularity in the art of metal spraying is the fact that pure molybdenum, with a melting point over 4600° F., sprays readily with the oxyacetylene flame but cannot be welded, and is melted with difficulty with a torch using the same gases. In explanation of this, it is highly probable that greater melting efficiency obtains in the metal-spray process. Other instances showing a variance between the two processes will make themselves manifest to the experienced welder in his adoption of metal spraying.

The question of bonds in the respective processes is another subject for comparable consideration. A good weld is, above all, a food fusion, with proper melting of the base metal, alloying, puddling and fluxing. Metal spraying cannot or seldom wishes to use any of these methods. Industry has adopted welding so thoroughly, and successful welding is so reliant upon a fusion bond, that engineers sometimes forget that there are many other bonds that are fully adequate for their respective purposes. Electro-plating, hot dipping, and even brazing are in no sense fusion bonds, yet they serve adequately. Metal-spray bonds are probably as thoroughly mechanical as electroplating bonds, yet are usually as efficient as those obtained by the best type of brazing.

Grit-Steel Blasting Makes for Good Bonding

Simultaneous with the development of larger-capacity guns, improvements in bonds were made, particularly on machine elements. Since sprayed metal deposits will not adhere to smooth polished surfaces, sand or grit-steel blasting has in general been the only bond preparation used until recent years, and is still used exclusively on tanks and large or flat areas. This preparation provides sufficient bonds for thicknesses of from 1/1000 to 1/32 in., depending upon the melting point and, in direct ratio, the ductility of the metal deposited. Possibly early efforts to build up machine elements, which deposits are usually a minimum of 1/32 in., met with mediocre success because other bonding methods than blasting were not then developed.

Machine Tooling Makes Deep-Cut Surface for Bonding

As blasting was primarily for the purpose of roughening and developing under-cuts, key-fasts and anchorage for the molten deposits, a natural conclusion was the use of machine tooling to accomplish this purpose on a scale which would support the heavier deposits necessary in building up worn shafts, for example. These took the form of lathe thread cuts, rough cuts and knurling to increase the anchorage and area of the bonding surface, after which the surface was lightly sand-blasted before spraying to remove any possible oil or moisture and roughen up any small intermediate smooth areas to insure maximum adhesion of the molten metal. A standard, smooth thread cut only will not provide an adequate bond.

The most successful bonds obviously are those having the greatest number of anchors against which the sprayed metal can mechanically interlock. Bonding procedure, while not intricate, should be sponsored by metal-spray-gun manufacturers or experienced operators at the start. Bonding procedures are no more arduous nor less important than the melting down of the base metal to perform a good weld, but nevertheless many failures result from both practices when inexperienced operators fail to follow accepted control procedures.

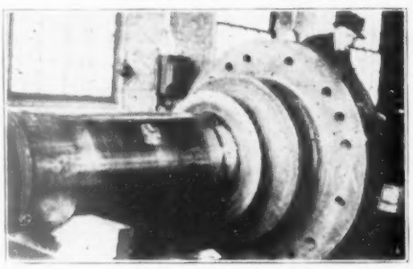

Fig. 4. Ore-Crusher Shaft Built Up by Spraying With Cold-Rolled Steel.

(This shaft, 22½ in. in diameter, 16 ft. long, and weighing 13 tons, had a worn section 12 in. wide, which was built up by spraying 87 lb. of steel onto the worn area. The total time was 75 hours, including machine preparation, spraying, and finish machining. The babbitt for the bearing also was sprayed.)

Of several methods of lathe tooling, when performed by experienced operators, little difference in bond strength is evident. The majority of operators apply a thread cut of from 16 to 26 threads per inch, dependent upon the diameter of the shaft, and then lightly blast with sand or grit. This procedure has been used over a period of about five years by many hundreds of operators on thousands of jobs with highly satisfactory results. Unquestionably there will be better bonding procedures in the near future which will strengthen the mechanical interlock of the sprayed metal, and a superior standardized practice of surface preparation will obtain.

Circumferential Build-Ups Withstand Severe Service

All types of circumferential build-ups involving industrial bearings have been made, some of which are operating under temperatures up to 1500° F., and pressures up to 2500 lb. per sq. in. Diameters run up to 30 in., and all

20th ANNIVERSARY—1916-1936

I WANT to take the occasion of your 20th anniversary to acknowledge the debt of our industry to the early advocates of welding. Too often proper credit is not given to the initiators of new enterprises. Contemporaries usually regard the promoters of things embryonic as visionaries. Later converts, flushed by success easily attained, are prone to belittle the first crude steps of those who lay the foundations for the development of the new ideas.

Happily, the participation of "The Welding Engineer" in the elevation of welding to its present important position, extended through twenty of the most fruitful years in the renaissance of this ancient art. The founders of "The Welding Engineer" are to be congratulated upon their foresight regarding the possibilities of welding, and the present staff for maintaining an enthusiasm which has gained for welding a well-earned recognition from a skeptical engineering profession.

With best wishes for your continued success,

—A. J. MOSES,
The Hedges-Walsh-Weidner Co.

* * *

CONGRATULATIONS! I salute you on your Twentieth Birthday.

The place of the trade journal in American industry is deeply rooted, and "The Welding Engineer" has been a constructive force in the oxygen-fuel-gas industry through all these years. It has always been careful to expound the best with respect to materials and method.

Hail! May you live long and prosper.

—C. O. EPPERSON,
President, International Acetylene Association.

* * *

HEARTY congratulations on the 20th anniversary of "The Welding Engineer." You have done a grand job during all these years—keep up the good work!

—HENRY BOOTH,
Shawinigan Products Corp.

* * *

WE CONGRATULATE "The Welding Engineer" on its 20th Anniversary.

"The Welding Engineer" has always commanded my greatest respect because it was founded at a time when the welding profession was relatively new, and because it continued to survive during the time when publications as well as all sorts of industries had to have quality in order to survive.

It goes without saying that a magazine that has so long commanded the attention of engineers throughout America and in many foreign countries must have given a valuable service to welders and others interested in welding. Throughout the years the pages of "The Welding Engineer" have been used to explain and make easier to experts as well as beginners, the best-known applications of welding. Undoubtedly there are thousands of welders who owe much of their success and their education in welding to your magazine.

May it continue to give the help that welders need and will always welcome regardless of their location or their ability.

—D. E. STALEY,
Stoody Company.

* * *

WE WISH to extend our sincere congratulations on the 20th anniversary of the founding of "The Welding Engineer." Your periodical has always been an unprejudiced recorder of the continual progress of welding. Our company was founded five years after yours—in 1921. The greatest improvement to welding noted by our organization was the introduction of the heavy-coated electrode, which made possible the efficient electric welding of oil, gas and water lines. Since 1928, when this improvement was made, over 10,000 miles of such lines have been electric welded. Our company alone has welded 4,500 miles of various sized pipe ranging from 4 to 54 in. in diameter. Wishing you continued prosperity in the future.

—HAROLD C. PRICE,
President, H. C. Price, Inc.

types of available metals have been deposited on these parts with highly satisfactory results in service.

Failures have been less in the machine-element field than the average of the early welding efforts. Circumferential or shaft deposits are most popular primarily because of the ease and economy of bond preparation. Many other types of machine surfaces are sprayed, however, the bond being prepared with a shaper, boring machine or even with a manually operated air hammer.

Sprayed Deposits Produce No Warpage, and Aid Lubrication

It is obvious that metal-spray deposits cause no warpage, distortion, or heat strains; but it is also true that the deposited metal has only a fraction of the tensile strength and ductility of weld metal. Sprayed metal does, however, have the ability to withstand all duty for which it is intended and, furthermore, through selection of metal to be deposited, it is possible to provide a wearing surface infinitely superior to the original bearing surface. As all depositions are relatively thin, there is but little reduction in the tensile strength of the part. On the other hand, the granular structure of the sprayed metal compared with the original metal or with weld metal provides means for better lubrication, and many field reports indicate longer service for this reason. It should be borne in mind that sprayed metal is cast metal. In finishing, it is turned or ground, depending upon the character and hardness of the metal applied.

In general, welding should be used for heavy deposits on small areas, while sprayed metal applies to thin deposits on large areas. The building up of the customary worn areas on shafts has often been a difficult and questionable application by welding regardless of refinements made during the past 20 years.

The average wear on a shaft seldom exceeds ⅛ in. on the diameter, and whatever welding method is used a full ⅛- to ¼-in. deposit on the side is necessary when repairing. A sprayed deposit requires but 1/64 in. over the finished size to clean up, and therefore about one-half the amount of metal need be deposited, with considerably less machining or grinding.

It is obvious that metal spraying is far more economical and satisfactory for this particular type of application, which welding never fitted fully. Yet welding may always be superior for small-area, heavy-deposit machine-parts applications.

Any Metal in Wire Form May Be Applied to Any Other Metal

Since fusion of the sprayed metal with the base metal is not necessary nor even desirable, it is apparent that any metal may be applied to any other metal, and the various restrictions pertaining to alloying in welding need not be observed. Therefore, full consideration may be given to utilitarian desires to accomplish the best service results. A cast-iron piston may be built up with aluminum, a bronze shaft with monel, a low-carbon-steel plunger with stainless steel or the reverse, or, insofar as the process is concerned, with any metal available in wire form.

Spraying Is Preferred to Welding for Some Jobs

There need be no controversy between welding and metal spraying if each keeps to its natural field of application. But since welding is so universally used, its availability in all plants has caused it to be used sometimes where other methods would have served better. Welding has never been able to develop the very large field represented by the building-up of worn areas on shafts or other circumferential worn areas primarily because of warpage, heat strains and other inherent objectionable features. This is such a natural field for metal spraying that students of both processes realize that the latter method will be used extensively for this purpose

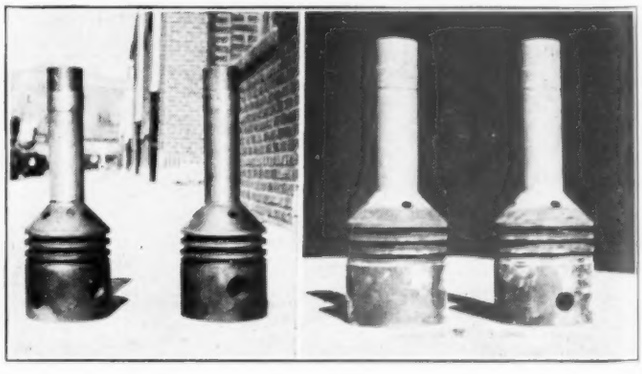

Fig. 5. Compressor Pistons Repaired by Welding and Spraying.

(First, the narrow ring sections at the top, or high-pressure end, were repaired and built up by welding, and then the diameter of the entire high-pressure section was increased by spraying with stainless steel.)

20th ANNIVERSARY—1916-1936

DURING its twenty years of existence, "The Welding Engineer" has witnessed practically all the important developments of the welding industry. This is especially true of arc welding, and in the last several years you have seen the science of welding virtually revolutionized by the shielded-arc type of rod. As compared with the sketchy guesswork of twenty years ago, the development of electrodes has become an exact science. Welding engineers have learned, by experiment, the exact influence that any element or chemical combination, when introduced into the coating, will have on the arc stream and the weld section. "The Welding Engineer" and its staff is to be congratulated upon the helpful part it has taken in the development of the welding science.

—F. E. BURK,
Central Steel & Wire Co.

* * *

PERMIT us to extend to you our most heartiest congratulations on the Twentieth Anniversary of the founding of "The Welding Engineer" and our sincere wishes for its success. You are doing an essential and worthwhile job in a splendid and effective fashion, and we hope that for at least another twenty or thirty years we shall have the pleasure of seeing you at the helm of this publication which has done so much to extend the utilization and scope of the arc-welding process by the dissemination of accurate and essential technical data.

We have nothing but praise for the editorial policy for which you are responsible, and the only criticism that we possibly might make is that sometimes you wield a mean blue pencil on the manuscript of a poor author.

—R. NOTVEST,
J. D. Adams Company.

* * *

OUR congratulations on the 20th anniversary of the founding of "The Welding Engineer."

So far as we can determine, by careful surveys of the field, gas welding and cutting is only used to about 20% of its possibilities. The industry needs and should take full advantage of the splendid educational work that is being carried on by "The Welding Engineer."

With best wishes for your continued success.

—E. L. MILLS,
Vice-President,
The Bastian-Blessing Co.

* * *

I AM pleased to note that the January, 1936, issue of "The Welding Engineer" marks the 20th anniversary of your publication.

Welding as a production method is being increasingly applied throughout industry.

Those of us who are engaged in the production of metals and alloys, both ferrous and non-ferrous, recognize clearly that adaptability to welding is a present-day requirement of an industrial metal.

Personally, I expect to see within the next few years a still more rapid extension of welding as a fabricating method than has occurred in the past few years. I am certain that "The Welding Engineer" will continue to serve this rapidly expanding branch of industry as usefully as it has in the past.

—R. A. WILKINS,
Vice-President,
Revere Copper and Brass Incorporated.

* * *

THE Welding Engineer is to be congratulated on your 20 years of successful operation. It has played a very important part in the advancement of the welding profession, showing impartiality to no particular method of welding, and as a consequence, deserves the leadership it possesses.

This thought I am sure is the sentiment of executives, engineers and welders alike.

As a pioneer in the field, you have done your job well. I trust you may continue to be successful, as we would be lost without you to lean upon.

—JOSEPH M. JARDINE,
Western Welding & Boiler Repair Co.

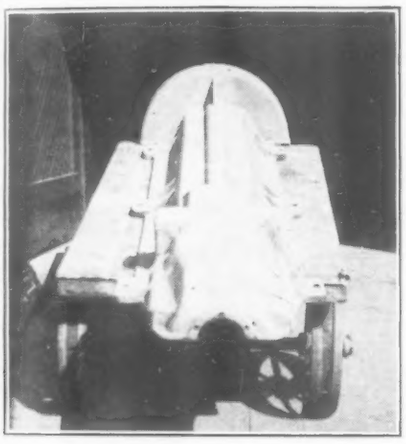

Fig. 6. The Life of Aluminum Crankcases, Exposed to Sea Water, Can Be Prolonged by Spraying With Lead.

in the near future. It should also be noted that when 1/8-in. diameter rods are used, a spraying capacity of 6 lb. of steel per hour is obtained. This is greater than the average welding capacity; and since much less metal need be deposited to accomplish a shaft build-up, spraying often has a large time and cost advantage.

Spraying May Be Solution to Cracked-Cylinder-Block Problem

From the latest field reports, there is practical evidence that spraying may take over a job that welding never relished. Cracked automotive cylinder blocks have usually given concern to some of the best welders. Spraying is making excellent progress in this field, and because of the absence of heating of the blocks, it holds good promise of success. This application, however, is in the experimental stage and will have to go through the inevitable degrees of improvement and meticulous observation of proven methods before it may be recommended with the proper degree of confidence to established customers. This process is susceptible to the same principles that pertained to welding in its early stages; one bad job or failure will be remembered long after many satisfactory jobs have been performed. Such is the difficult part of pioneering a new field of work.

Spraying Produces Continuity of Galvanized Surfaces

Aside from the spraying of machine parts, there is one application which is so close to welding practice that it should be briefly mentioned. When welding replaced riveting in tank construction, the volume of galvanized plate used was greatly reduced because the continuity of the zinc surface was destroyed at the welded seams. Although welds were sometimes painted or treated with some non-metallic composition, obviously the uniform corrosive resistance of the whole surface was lowered and the protection given became no better than its painted portion. The spraying of from 0.003 to 0.005 in. of zinc on the welded areas fully corrects this condition, and easily meets all the usual tests applied to galvanizing. As a result, the use of welding on galvanized plate will increase, supplying an additional volume of business to both processes and a highly improved product to the user.

Spraying Closes Up Porous or Impervious Welds

Porous or impervious welds may be corrected, with few exceptions, by spraying. When the sprayed deposit is applied on the inside surface of the pressure receiver, the results are invariably successful, but even when applied outside satisfactory results are often produced.

Spray metals used for the building up of machine parts are usually those of the higher melting points, such as brass, the various bronzes, monel, stainless-steel alloys, low-carbon and high-carbon steel. All are readily machined without the use of special tools, except that abrasive-wheel grinding must be used on deposits of steel having a carbon content of about 0.70% or over.

Carbon Content Is Reduced More in Spraying Than in Welding

High-carbon steel is being used in rapidly increasing volume for machine elements. The average carbon content is from 0.75% to 1.00%, and the sprayed deposit has a hardness of 300 to 400 Brinell. It is possible to use wire of much higher carbon content than with welding, because from 20% to 40% of the carbon content is lost in spraying. With steel of 1.25% carbon content, a 400 Brinell hardness is obtained.

Chemical analysis of 18-8 stainless-steel sprayed deposits showed a loss of 10% chromium, 2% nickel and 40% carbon. The first two losses are not serious, but the latter is advantageous in retaining non-corrosive characteristics.

Welding usually increases the carbon content, but even though a strong carbonizing flame is used in spraying, the carbon content or relative hardness is not perceptibly increased.

The machine-element field is the least experimental, obtains quick and satisfactory results, may be fitted into the machine and welding-shop business, and any competent mechanic may easily learn the methods used. Procedures, costs and results will be given covering a few typical applications illustrating a

20th ANNIVERSARY—1916-1936

CONGRATULATIONS to the staff of "The Welding Engineer" on the completion of 20 years of service to the industry. It is through such untiring effort in the publication of useful and valuable material that the tremendous progress made by the welding industry since the dawn of the 20th Century has been possible. May you continue in this service to celebrate your centennial.

—DAVID H. MERRILL,
Managing Secretary-Treasurer,
Pacific Coast Building Officials Conference.

* * *

I FEEL highly honored to be asked to contribute to the January, 1936, issue of the outstanding magazine on welding for the past 20 years, and to be able to take part in the celebration marking the 20th anniversary of the founding of this publication.

I have my copy of the first issue (Jan., 1916) and a copy of every issue since then up to the present time, and will continue to be a booster and subscriber as long as it is published, as the magazine begins where the books leave off.

Welding progress was given an impetus in January, 1916, through the first issue of "The Welding Engineer" and each succeeding issue has contributed to this progress.

Through its editorials and articles "The Welding Engineer" has: (1) increased the application of welding, brazing and cutting; (2) interested a great many individuals and companies directly and indirectly connected with the welding industry; (3) promoted the art of welding through education; (4) caused the establishment of many schools of welding; (5) advocated and outlined correct training programs for operators and others; (6) made possible the compilation and publication of the outstanding textbook on welding for all educational institutions, operators and executives, "The Welding Encyclopedia"; (7) caused the development and adoption of new and better rods and electrodes, weldable material, equipment, processes, technique, certification of operators and manufacturing plants, design and procedure; (8) made itself indispensable to all industries and persons using welding as a fabricating or salvaging process; and (9) enabled the welder and employer to adopt processes intelligently to new conditions.

Today we know why it is impossible to do a good job of practical welding, brazing or cutting without someone having a knowledge of the scientific side, and how to appreciate specific knowledge and specific rules so as to act and judge more quickly and be relieved of the tedious hit-or-miss game practiced in the past.

When you do something it is useful to know why. We have to thank the pioneer publication on welding, "The Welding Engineer," as the medium that made our great progress in the art of welding possible.

Progress in fusion welding has made imperative the ability to analyze any application as follows: (1) what is the chemical make up of the parent metal? (Metallurgy.) (2) What is the structural make-up of the parent metal? (Metallography.) (3) How is the parent metal affected by heating, cooling or working? (Metallography.) (4) What chemical elements or compounds will benefit or harm the weld? (Metallurgy.) (5) What is the functioning factor of the piece being fabricated or repaired? (Physics.) (6) What is the purpose of the weld on this job? (Physics.) (7) What allowance is to be made for expansion and contraction in order to avoid working, cracking, stresses or strains? (Physics.) (8) Will heat treatment be necessary? (Physics-Metallography.)

It was while serving as a foreman and supervisor of welding in an industrial plant that I read the first issue of "The Welding Engineer" and immediately saw the valuable aid it could give industry as a whole, and it was then I began seriously to study welding both from the practical and scientific sides. As a result, when I was called into the educational field five years later (1921) I had a background of knowledge that was invaluable to me. I consider "The Welding Engineer" the outstanding magazine for the dissemination of welding knowledge and technique.

—A. G. ODELL,
Lecturer and Director of Welding Instruction, Denver Public Schools.

class of work that will apply to the average industrial plant. The building up of worn, scored, pitted, or undersized surfaces of shafts, sleeves, rods or pistons, forms a large part of what is known as machine-element applications.

A built up Corliss-steam-engine piston rod is shown in Fig. 1. This rod, which was 18 ft. long, had became pittted from some undetermined type of corrosion. It could have been reduced in diameter and smaller special-size packing rings used, but it was desired to keep the diameter standard with several other similar units, and, if possible, to also prevent future corrosion, so it was decided to apply 18-8 stainless steel. Many comparisons may be drawn with respect to alternative methods of repair, cost and time of replacement with a similar carbon-steel rod, or with a stainless-steel rod, but the greatest value of this application lies in the indicative use upon the many other structures of this size and class.

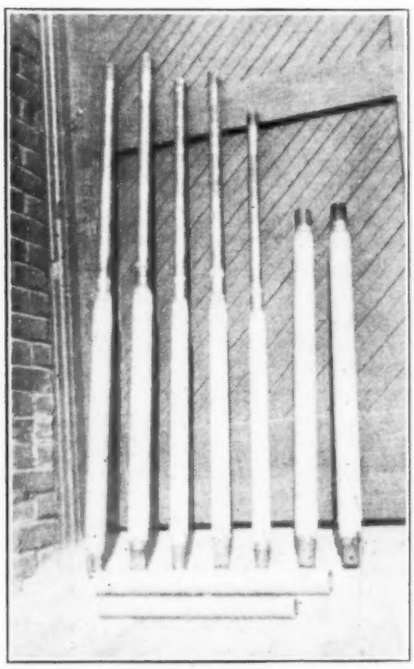

Fig. 7. Monel-Metal Pump Rods and Sleeves Built Up by Spraying.

(The items shown are from locomotive feedwater heaters, and are 1¾ to 2¼ in. in diameter. The worn sections are 18 to 36 in. long. Such parts are taken out of service when reduced in size 1/16 in. by wear. Replacement costs vary from $25 to $60 per item. Sprayed with monel metal and brought to their original sizes, they cost repaired $10 to $20.)

Valve Rods and Crankshafts Are Reclaimed by Building Up

A repair that has come into common use and is handled similarly in every respect, is the building up of worn areas on Corliss-engine valve rods (see Fig. 2). Most engineers prefer stainless steel or high-carbon steel to obtain longer life than the original items, the choice depending upon the degree of corrosion or abrasion in service, while others are satisfied to use low-carbon steel and obtain at least equal length of service compared to the original. Any such sprayed areas may be re-sprayed many times, but it is usually advisable to remove any remaining portion of the old sprayed deposit.

Worn areas are often found on ice-machine crank shafts. For building up, stainless, low-carbon, and high-carbon steels are commonly used, the first mentioned being most popular (see Fig. 3). All types of crankshafts and all types of bearing surfaces thereon are now common practice with this process. Some shops specialize in this one application, obtaining sufficient business to maintain three shifts. But high-carbon steel is used almost entirely on automotive connecting rods and main bearings, since longer service is obtained, and abrasive grinding is necessary, in any case, to properly finish such bearings.

Key-ways are no deterrent to sprayed shaft deposits, even though they fully bisect the deposit. Dummy keys are usually inserted to blank off the key-way area, and are then removed after machining to size is completed. But if the key-way is oversize, or the edge broken or damaged, the welding process should be used, as spraying of such sections would not give the required strength.

An instance covering mining machinery in Canada is that of a worn shaft on a Traylor ore crusher (see Fig. 4). In addition to the repair of the shaft itself, the babbitt for the bearings on this shaft also was applied by spraying instead of pouring in the usual way. Babbitt-bearing spraying is a comparatively recent development and therefore still in the experimental stage, but it has high merit and excellent potential possibilities.

Compressor Pistons Built Up by Welding and Spraying

Metal spraying is often combined with welding to the advantage of both. Fig. 5 shows high- and low-stage compressor pistons after welding and spraying, respectively, on the high-pressure sections. Some of the narrow ring sections were broken and were built up by welding, since tensile strength was an important requisite. The diameter of the entire high-pressure area was then increased by spraying with stainless steel.

All types of compression and internal-

20th ANNIVERSARY—1916-1936

I CONGRATULATE "The Welding Engineer" upon the completion of twenty years of outstanding service to the welding industry. I am convinced that your publication has had a great influence in promoting and developing the use of welding for the fabrication of metal structures and machines by bringing to the attention of designers and executives the great advantages of welding over the older methods of joining structural elements and by setting forth clearly and forcefully the best methods of making the welds.

In my opinion the most important achievements in welding during the past twenty years are the development and use of definite welding procedures with qualification tests for welders and specifications for electrodes and welding rods based upon definite mechanical requirements for the welds made with them.

These weld-metal specifications have resulted in a tremendous increase in the ductility of the welds, which in turn has greatly extended the field for welding to the benefit of the public through increased safety and decreased cost.

—H. L. WHITTEMORE,
National Bureau of Standards.

* * *

THE C. G. M. A. salutes "The Welding Engineer" upon the completion of its 20th year of service to the welding industries. For fifteen of those twenty years your company has been a member of this Association and it has been our privilege to follow the progress of your development and to know intimately your splendid work in promoting the uses of welding and in the advancement of the art.

—F. R. FETHERSTON,
Secretary, Compressed Gas Manufacturers' Association.

* * *

THE founders of "The Welding Engineer" are to be commended for their courage in launching a publication confined to welding, so shortly after the process was first adopted in this country, and are to be congratulated for the excellent manner in which they have served the welding industry.

Only a few years ago welding developments were by the shop men, usually without the knowledge or consent of the engineers. But today the engineer is sold on welding, and designs are being rapidly changed to permit fabrication by welding, not because it is a cheaper method of fabrication, but because it is a better method and makes possible the construction of structures and equipment that could not be made by any other available means.

The welding industry has grown to such importance that today every new steel specification is carefully scrutinized to determine whether it can be successfully welded, and new compositions of high tensile strengths have been developed especially for welding.

Just think what the welding industry will be twenty years from now, if the same progress is made in the next twenty years that was made in the last twenty years.

—JOHN J. CROWE,
President, American Welding Society.

* * *

I WISH to let you know that I have heard several comments among prominent welding men that your magazine publishes more interesting papers, about resistance welding especially, than any other trade magazine.

Concerning the progress made in the last 20 years in electric welding, I think the most important things were the development of the projection welder, the flash welder and the improvement of the spot-welding method, due in no small part to the fact that we now have dependable current controllers and high-alloy electrode material. Personally, I believe that the resistance-welding industry has developed far too slowly. The reason for that may be that most of the manufacturers have been too busy filling the demands for the present equipment, and have not devoted the necessary time to research and development work.

I am firm in the belief that within the next 5 years development, especially in the resistance-welding field, will completely revolutionize that field. I am already in possession of facts which strongly indicate that.

—P. W. FASSLER,
Fassler Welding Machine Co.

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combustion pistons and cylinders are sprayed to replace wear, with very satisfactory results. The ring-groove sections are usually given the benefit of special bonding methods. High-carbon and low-carbon steels are favored, and service records are now available over a period of several years. Comparative cost with replacement indicates the economical field is on pistons of 8-in. diameter or over; but if cylinders are re-bored beyond the actual wear, it is sometimes not economical to build up to the re-bored size. The time element is frequently the deciding factor, for the largest piston may be built up in one working day with one large-capacity gun.

Crankcase Corrosion Checked by Spraying With Lead

Aluminum crankcases are subject to very rapid corrosion when in contact with bilge water in ocean or salt-water service. The case shown in Fig. 6 was corroded through at several points, releasing the lubricating oil. The larger openings were welded; but to close the smaller holes and porous sections, and to prevent all further possibility of corrosion, a 0.020-in. coating of sprayed lead was applied to the entire lower section at a time and material cost of but $4.00. The customer valued the sprayed portion of the job at $25.00, advising that a repetition of the last breakdown experienced might cost several hundred dollars.

Old-timers will fondly recall the many crankcases that brought in a sum equivalent to half their replacement cost, for a few minutes of welding. Spraying is going through the same cycle that welding was in those days, but modern business training dictates a careful consideration for future business. However, a process growing as rapidly as metal spraying places a premium on experienced, skilled operators, and the higher profits paid are earned and fully justified to reimburse the expense of pioneering.

Applications of Spraying on Steam Railroads

Two applications which have been adopted by one major steam railroad are of interest. Monel-metal pump rods and sleeves are used for feed water heaters on most locomotives. When worn they can be repaired by metal spraying (see Fig. 7), and the saving is so large that excellent profits are realized by the job spraying shop and the customer. No other method of repair is as satisfactory or economical. Obviously this one application presents some attractive profitable future business in large volume.

The spraying of a bronze link block for a locomotive valve-reversing mechanism with high-carbon steel is shown in Fig. 8. This highly resistant wearing surface prevents galling of the link in the link block and increases the life of the bronze link blocks many times. These high-carbon-steel surfaces are equally applicable to wrought-iron link blocks, and eliminate the necessity of case-hardening.

Metal spraying and other similar processes are usually used for repair and reclamation field work for some time before manufacturers adopt the process for production purposes. One instance in the field of production will be cited to briefly outline some of the requirements. A national manufacturer

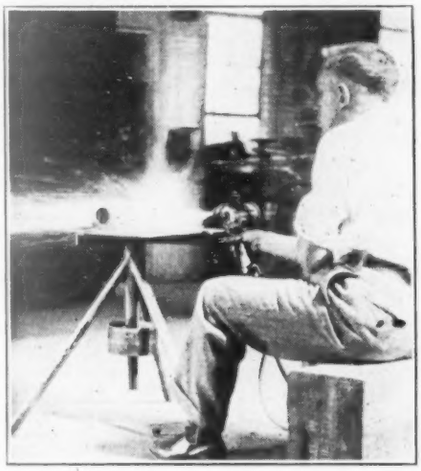

Fig. 8. Spraying a Bronze Link Box for Locomotive Valve-Reversing Mechanism.

(The 3x6-in. faces of these blocks are roughened in a shaper, sand blasted and sprayed with steel of from 0.85% to 1.25% carbon content, the deposit averaging 1/16 in. thick when ground to size.)

of deep-well water turbine pumps uses cast-iron bowls and cast-iron impellers having wear-ring bearings varying in size from 4 to 12 in. in diameter and from 1 to 2 in. wide. Bronze wear rings were previously shrunk on at an approximate cost of $2 each for the average-size impeller. Phosphor bronze is now being sprayed on these sections at a saving of 50%. It was previously difficult to obtain the correct size of stainless-steel rings, even though the cost was excessive; but with the metal-spray gun, whenever customers desire, these surfaces are being built up with stainless steel at a total cost of about $1.50 each.

Fig. 9 shows a fully automatic machine constructed for this purpose. It gives a vertical movement to the gun

20th ANNIVERSARY—1916-1936

ON the occasion of the 20th Anniversary of the founding of "The Welding Engineer," I want to add my sincere congratulations to the host of others that I am sure you will merit and receive as a result of your two decades of constructive service to the welding industry.

For many years prior to the establishment of Lukenweld, Inc., in 1929—in fact, since the early days when welding was primarily a maintenance tool—I have enjoyed reading "The Welding Engineer" each month. Your editorial content has always been interesting and instructive. I have been particularly impressed with your evident editorial policy, continued through the years, of publishing welding news and welding information, without regard to selfish interests and uncontrolled by advertising patronage.

While twenty years may be a short span in the life of publications in other fields, it represents a period in the welding industry in which the art has grown into an established factor of maintenance and construction in all industries. It has been a difficult period of development for the welding industry and an equally difficult period for a welding publication. That "The Welding Engineer" has survived is, I feel, a concrete tribute to its work in the past and it is my sincere hope that "The Welding Engineer" will carry on to further achievements in the future.

Just about six years ago, Lukenweld, Inc. was organized as a division of Lukens Steel Company to design and manufacture welded steel structures for use in machinery and equipment. As far as I know we were the pioneer in the field, as I believe we were the first concern to function commercially as a supplier of welded machinery parts.

Like the welding industry and "The Welding Engineer," we have gone far in the short space of a few years. Our early efforts, viewed in the light of present-day knowledge of welding design and welding fabrication, seem crude and old-fashioned, although they were real welding "news" in their day. Today, as daily commercial practice, we are producing welded steel Diesel-engine frames, welded steel railway trucks and underframes, and welded steel machinery structures of a wide variety of types which are standing up satisfactorily in service. Only a few short years ago, the very thought of fabricating by welding some of the highly stressed structures which are now part of our daily work, would have been approached by the average engineer with fear and tremor.

It is a matter of record, demonstrated by years of actual service, that properly designed and properly fabricated welded structures are serving satisfactorily in thousands of industrial uses. There have been failures, of course. Facts again prove that the failures have been only a small fraction of the total number of welded structures in service. Naturally, the proponents of manufacturing methods competitive to welding have made the most of the comparatively few welding failures that have occurred, and since those failures are not fundamentally critical of the welding process (because they have been the result either of poor design or improper welding, or both) it is incumbent on us all to assure proper design before fabrication begins, and to improve shop practice so that only the finest welding that can be produced goes into machinery and equipment structures.

In six years, the use of welding in machinery and equipment has changed from an innovation to an established practice with leading industrial concerns. How true this is was shown by a recent survey of 101 companies, of which 74 were using welded structures in their machinery and equipment. Of the remaining 27, several were contemplating the use of weldings in the future. Of the 74 concerns using weldings, 41 did their own fabrication, 8 purchased all their welded structures and 25 made some of their own and purchased some of their requirements. Here in this survey is a definite indication of the growth of welding in machinery and equipment. Scores of manufacturers are learning to use welding; most of them will do their own fabrication. Jobbing welderies have been and will be set up in increasing numbers throughout the country. Where Lukenweld was alone as a jobbing weldery only a few years ago, hundreds of concerns, functioning wholly or in part as jobbers of weldings for machinery and equipment, now are spotted throughout the United States. That is a natural and healthy development. It will continue, but we must recognize the limitations of welding and apply it only where it is the proper method of fabrication. We must also recognize that, along with steel plate as the basic material of welded structures, there is definite need in many cases for the use also of castings, forgings, rolled shapes, etc., in combination with welded structures. Most important, welderies must be certain of proper design for welding, and then of proper welding fabrication, so that welded steel structures will render satisfaction in the service for which they are intended.

—G. D. SPACKMAN,
President, Lukenweld, Inc.

equal to the width of the sprayed surface and revolves the impeller at the desired speed. The gun operation is continuous if desired, as a finished impeller may be lifted off and replaced with a similar item in a few second's time. The wear-ring section of the bowls is treated similarly, and this manufacturer is also beginning to apply stainless steel to the bearing sections of pump shafts. It is remarkable that there has not been a single complaint or return of a sprayed impeller in a period of almost a year, involving more than a thousand items.

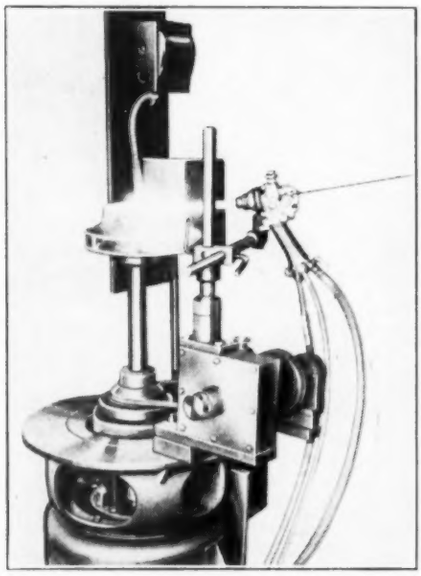

Fig. 9. Automatic Machine for Spraying Wear-Ring Surfaces Onto Pump Impellers.

(This machine gives a vertical movement to the gun equal to the width of the sprayed surface and also revolves the impeller at the desired speed.)

These case histories represent but a few of the metal-spray applications that were started not long ago in an experimental way and which today are standard practice in many large industries.

San Francisco Section Are Guests of Railway Club

The San Francisco Section of the American Welding Society accepted an invitation from the Pacific Railway Club to be the guests of the Club at their meeting on Thursday evening, January 9th. The topic of the meeting was "Welding in Railroad Shops," and the speakers included C. A. Daley, maintenance-of-way engineer, Air Reduction Sales Co., New York City, and Frank Longo, supervisor of welding, Southern Pacific General Shops, Los Angeles, and past chairman of the Los Angeles Section of the American Welding Society.

Campbell Orders Four More All-Welded Tank Barges

A contract for the construction of a fleet of four all-welded steel tank barges has been awarded the McClintic-Marshall Division of the Bethlehem Steel Corp. at Pittsburgh, Pa., by the Campbell Transportation Co., also of Pittsburgh, who will use the barges for the movement of gasoline and fuel oil on inland waterways.

With the completion of these barges, as well as two under construction at Midland, Pa., by the Treadwell Construction Co., the Campbell Transportation Co. will have a fleet of six new carriers for the movement of petroleum products. The cost for the entire fleet is placed at approximately $200,000.

The new barges will be 195 ft. long, 35 ft. wide and 9.6 ft. deep, and will have a capacity of 8,600 barrels each. They will be of the metallic-arc-welded type and will require about 1,200 tons of steel plates and shapes. The carriers will also be equipped with unloading pumps and piping devices and will be used in local and long-distance movement of petroleum products. Delivery will be made next spring.

Hears Talks on Welding by Atomic-Hydrogen Process

The Los Angeles Section of the American Welding Society will hold its regular January meeting on the evening of the 23rd in the Chamber of Commerce Building, at 12th and Broadway.

H. U. Baker, chief engineer, of Roscoe Moss Co., will talk on "Applications of Automatic Atomic-Hydrogen Welding Process in the Roscoe Moss Plant." E. J. Cipperly, arc-welding specialist of the General Electric Co. (Los Angeles branch), will give a general discussion of atomic-hydrogen welding. Mr. Cipperly's talk will cover the subject as it applies principally to well and drilling casing and other tubular goods.

At this meeting, a nominating committee will be appointed for the election of officers for the year 1936.

Portraits

By
MILDRED KINKEAD

Longfellow Up to Date

> Under a spreading chestnut tree
> The village smithy stands.
> The smith, a mighty man is he,
> With arms like iron bands.
> —Longfellow.

Many generations of children and grown-ups have learned "The Village Blacksmith" by heart. And although it has a sing-songy meter, and in some places an unnatural arrangement of words, both faults of which modern poets would disapprove, still the poem lingers in our American consciousness as something we like, for its inherent simplicity, for its authentic claim to a place in the history of American craft development, and most of all for the directness of its emotional appeal.

Often I find myself reflecting that I represent a link between two generations of thought in the process of joining metals. My father was a village blacksmith—as typically one as was the brawny man in the Longfellow poem. He practiced a form of welding when he joined the heated ends of wagon tires and hammered the bond into smooth cohesion. I often watched him do this, and sometimes, as a great treat to them, brought some of my schoolmates with me to watch the tire-welding operation. We did not dare to ask questions—father was a stern man in many ways and concentrated fearfully upon his work—and that is why we never knew the reason for what followed the welding. Father would build a fire of wood blocks and shavings in the shape of a ring on the ground outside the blacksmith shop. Carefully then he would lay the wagon tire upon the blazing circle. He kept adding more wood for a few minutes, while the wagon tire grew red-hot, then he would let the fire die out as the tire was left to cool slowly in the white ashes.

Father was a skilled mechanic who had inherited a set of practiced motions from his father, and from at least three generations of blacksmith fathers before him. He did not comprehend the why of his actions, and appeared to have little curiosity about the reasons for the things he did year in and year out in a competent manner.

It was only after I had married a welding man that I learned something about the mysteries of annealing. I know now why father always kindled the fire under the wagon tires before letting them cool, and why he always kept a wooden tub of water close beside his anvil. The water always had an acrid, metallic smell. (I remember it today across the gap of years.) It thickened up, too, with a rusty sediment when father stirred its depths as he plunged a sizzling horseshoe into the tub "to quench it." Father always said "quinch it" by some perversion I do not understand.

Of course time and a patient husband have elucidated the quenching process. Father could not explain it; he knew only that it was something you did after welding a metal. The implications of modern metallurgy would have left him aghast, but he was an excellent steel-treater and welder by inherited practice alone.

Although there are a few blacksmiths left in the American countryside, their work is largely horseshoeing, and even that craft is nearly vestigial in a motor age. What is left of blacksmithing has now been split off from the once intimately joined craft of horseshoeing, and forms a separate art.

The modern art of metal-joining is practiced largely by a growing group of craftsmen known as welders. The spreading chestnut tree is no part of their heritage of tradition. They work with new tools; brawn is not so necessary as it was when welds were sledged. Perhaps if Longfellow were alive today he could write another poem of tribute to the metal-joiner's art. Perhaps his imaginative mind could see poetic implications in the roar of the electric arc, in the deluge of sparks from the oxyacetylene torch. Perhaps a Longfellow could detect the universality of nature in the welding processes which have supplanted the art of the smithy.

But until some new Longfellow arises to celebrate the welding art, the famous lines about the village blacksmith remain as poetry's only tribute to the metal-joiner's trade.

* * *

Tenney's Mistake

Cleveland boasts of a spectacular real-estate development by the name of Forest Hill. Doubtless you, readers, have heard of it, with its miles of winding streets lined with costly residences just alike. To be truthful, they are not just alike—among the forty odd houses are perhaps a dozen duplications, but the effect to the casual visitor is that of a very de luxe tenement district. Native Clevelanders, having out-of-town visitors to amuse, are sure to exhibit to them the strange, fantastically costly whim of John D. Rockefeller, Jr., who built this carefully uniform, meticulously gardened community of houses upon the site of his youthful home.

When showing pop-eyed visitors about in the curving avenues of Forest Hill, Clevelanders have come to expect one question: "What would happen if you lived in one of those places and came home after a big night?"

Of course nobody knows the answer. Forest Hill residents are too close-mouthed, too snooty about their regimented dwellings, to answer any of the impertinences put to them by members of the world outside of their carefully tended confines. Forest Hill-billies (that's what the rest of Cleveland calls them, enviously) have their own exclusive way of existence. They have communal recreation-facilities and live to themselves under the elegant patronage of the Rockefeller rules and regulations for their tiny commonwealth, and the world sees little of them. Moving into Forest Hill is almost like joining a cult—you don't belong to the world thereafter.

This is a windy prologue to a short story. When I thought of the question eternally and everlastingly put to the Forest Hill people about the peril of coming home inebriated, I was reminded of G. E. Tenney, Lincoln Electric district manager, of Chicago, and the time he got all set to visit his sister. Not that Mr. Tenney's sobriety was in question, for it was not. As the story runs, it was a pleasant Sabbath morning when he hopped off a train in Columbus and decided to pay a surprise to his sister, whom he had not seen since she and her husband had been settled in their new house which she had described to him in glowing letters. A taxi set him down in the driveway and he tip-toed inside and called to his sister. Since she failed to answer, he assumed that she had gone to church, so he helped himself to his brother-in-law's brandy and smoking supplies and sat down with a copy of "Anthony Adverse" from a table near the comfortable leather armchair he had selected. He thinks he must have dozed off, somehow, because he found himself sitting up with a start when a perfectly strange man walked into the room. There were surprised inquiries and explanations, of course, and Mr. Tenney was sent on his way in a taxicab to another house in another street. He had tried to remember the new address of his relatives, with the shocking results set down here. However, a person knowing Mr. Tenney is sure that he would acquit himself with savoir faire, even in trying circumstances such as this.

Resistance Welding—I

Theory and Application . .

(First of a series of articles)

■ By L. H. FROST
Welding Engineer, The Electric Controller & Mfg. Co.

ABOUT 50 years ago the first resistance welder came into being for the butt welding of rods and bars. Shortly after this, the first spot welder was built, and for many years there was not much change in the designs of spot-welding machines, though they were applied to various classes of work. More variations existed in the design of butt-welding machines than spot-welding machine because of the various shapes of pieces butt welded as compared to the flat surfaces welded by means of the spot welder.

The essential parts of a spot-welding process are shown in Fig. 1. These parts consist of a transformer and of electrodes bearing on the two work pieces (shown as sheets). The transformer changes the power obtained from the line into power of large current and small voltage in the electric circuit where the work pieces are placed.

A schematic diagram of a type of welding machine in common use is shown in Fig. 2. In actual construction the transformer is not made as shown, but either the secondary coil is wound directly over the primary coil or the primary and secondary coils are wound in sections, in order to obtain closer inductive coupling between them.

The machine shown in Fig. 2 is operated by means of a foot pedal or a hand lever, and pressure is obtained by the compression of a spring in the movable head carrying the upper electrode. Operating either the foot pedal or the hand lever forces the upper electrode against the work pieces. Further movement of the lever or pedal compresses the spring; and after a definite movement of the spring, a suitable mechanical connection with the lever causes the contacts of the pilot switch to close. These contacts, in turn, energize the operating coil of the primary magnetic switch, which applies power to the primary of the transformer, causing current to flow in the secondary coil and through the work pieces. When the operator has observed that the weld is completed, he causes a further movement of either the pedal or the hand lever. This opens the contacts of the pilot switch, thereby de-energizing the coil of the magnetic switch, which opens the power circuit, thus cutting off the current. Release of the pedal or hand lever removes the electrodes from the work, and the weld is completed.

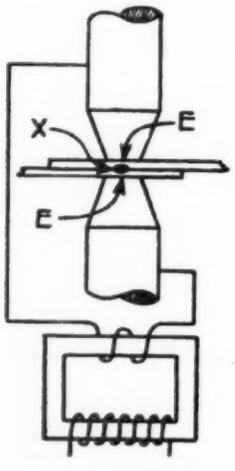

Fig. 1. Simple Diagram of Spot-Welding Process.

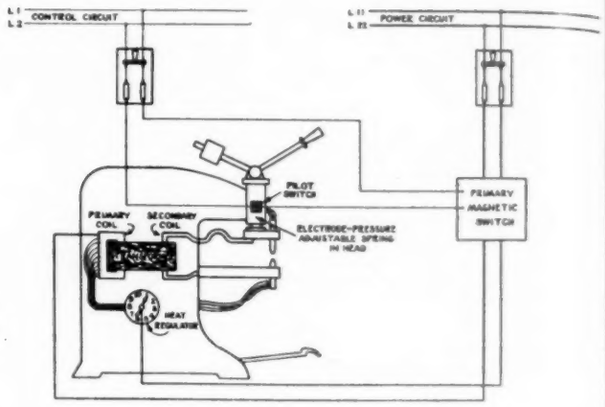

Fig. 2. Schematic Diagram of Typical Welding Machine.

Foot Pedal Controls Entire Welding Operation

Other mechanical types of machines are available, such as those having a straight arm extending across the top of the machine, in which movement of the foot pedal alone causes the welding operation to take place. Here the adjustment spring is at the rear of the machine, and after a suitable travel of the foot lever it closes contacts which may either operate a primary magnetic switch or close the primary circuit directly. As in the case of the machine shown in Fig. 2, further movement of the foot pedal opens this switch and cuts off the current.

The manual type of machine has been in common use for years, but for production work it was advisable to have some automatic means of repeating the welding cycle, and so motor-driven spot-welding machines were developed. In these machines, by the use of a suitable crank motion or cam motion, the operation of a clutch between the motor and the cam shaft serves the same function as operating the hand or foot lever. The most recent development in spot welders is the use of air or hydraulic cylinders in order to obtain the pressure and movement of the movable electrodes.

Current Flow Varied by Means of Heat Regulator

All spot welders are equipped with a means of changing the amount of current flowing through the work pieces, this being commonly called the heat regulator or heat adjustment. This regulator consists of a switch arranged to select taps on the primary coil of the transformer, thereby allowing the ratio of the transformer to be selected which will give the desired amount of current in the secondary coil. The common practice in the past has been to build welding machines for a maximum of 6 to 8 volts in the secondary circuit and a minimum of about 1 or 1½ volts. This range of voltage adjustment is, of course, obtained by the heat regulator.

Recent developments in welding machines have necessitated the use of higher voltages. Some modern portable machines have open-circuit secondary voltages as great as 22 volts. It should be remembered that although the voltage required to force a current of suitable magnitude through the work pieces is small, there is considerable voltage drop due to the resistance of the secondary circuit as well as its reactance. The reactance might be considered as

20th ANNIVERSARY—1916-1936

THE Welding Engineer is to be congratulated on its 20th anniversary of service to the welding industry. During these two decades, we have seen the art of fusion welding and modern torch brazing grow from mere curiosities to valuable and useful tools of the metal industry.

The writer recalls the sorry plight of a fellow machinist who, in 1906, undercut a heavy manganese-bronze gun-sight casting. The part was sent back to the bronze foundry and a grim warning given the machinist not to undercut the new casting. Had this happened in 1935, the casting would have been sent to the oxy-acetylene welder, the surface restored, probably with Tobin bronze or manganese-bronze welding rod, and remachined with little loss of time, labor or material.

However, the welding art gives us not merely a "putting-on tool" or a "repair tool" but it has developed into a new and better method of making connections in metals. Better, because the welded connection makes the parts more truly integral, avoiding leaks, squeaks and a shortened life due to mechanical wear and tear. Better also, because the stresses are transferred more nearly in a straight line across the joint. It is doubtful whether bolted, riveted or threaded connections would have enabled us to take advantage of the high-pressure, high-temperature steam power as it is now being used or the combinations of temperature and pressure used in the chemical industries to make products so necessary to our civilization.

"The Welding Engineer" has performed a valuable service in reporting each new development in the art. Nor is its usefulness ended with the present advance. While we are far ahead of 1916 in the application of this valuable tool, many new uses will most certainly be found. The very fact that the operator is given such a great concentration of energy in the electric arc or the oxyacetylene torch, means that it will take considerable time to find all the applications possible.

During the last decade, "The Welding Engineer" has borne witness to the development of by far the major part of the art of welding as it applies to the copper industry. The welding of copper alloys has grown from an occasional brazed or silver-soldered connection, in 1925, to the successful fusion welding of thousands of Everdur vessels. The Everdur metals developed during this interim have been accepted as much for their weldability as for their strength, ductility and corrosion resistance. There is now a workable welding procedure for nearly every one of the several hundred copper alloys in common use.

Methods for the welding of copper, Tobin bronze, aluminum bronze, manganese bronze, phosphor bronze, extruded architectural bronze, nickel silver, ambrac, supernickel, beryllium copper and other copper alloys have been developed and made available to the public through the help of publicity and discussions which have appeared in such mediums as your magazine.

We congratulate "The Welding Engineer" and wish for its continued success.

—I. T. HOOK,
The American Brass Co.

inertia of the electric circuit, and increases with longer electrode arms, wider spacing between electrode arms and if the iron inside the secondary circuit increases.

Special Alloys Required New Types of Machines

The early types of machines were highly successful in the welding of mild steel, but with the advent of special alloys these machines were found to be inadequate to obtain proper welds in the alloy materials.

A study of the theory of spot welding will show why these machines were used with success on mild-steel welding over a wide range of conditions, and why they are not suitable for all types of alloy welding. Fig. 3 shows two electrodes bearing on two sheets or work pieces, and at the right is shown the thermal gradient at the instant that current is applied and before the weld is made. The gradient curve shows that the heat is developed between the surfaces in contact rather than through the work pieces themselves. This is, of course, the ideal condition, since it is desired to make the weld at the point *C* rather than have the heat distributed through the pieces.

Since the amount of heat generated depends on the current flowing through the pieces and the resistance of the surface contact areas, it is evident that a change in current or a change in resistance will change the thermal gradient and the amount of heat generated at *C*.

With the standard type of resistance-welding machine, the current may be controlled by the heat regulator, but the contact resistance is determined by several factors, principal of which are: (1) surface condition of the material (rough, smooth, scaly, etc.); (2) type of material (low or high electrical conductivity); (3) shape and size of the electrode; (4) type of electrode material; (5) surface condition of the electrodes; and (6) pressure forcing the surfaces in contact.

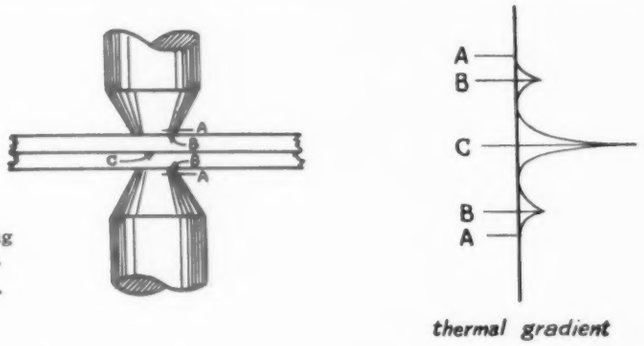

Fig. 3. Spot-Welding Set-Up and Initial-Temperature Curve.

The resistance, then, for a given problem in spot welding, may be reduced to only two varying conditions, which can be controlled within reasonable limits. For the specific situation, the surface and type of the material are fixed, but the shape, size, surface and material of the electrode and the pressure on the electrode can be adjusted to suit that type of material and surface condition.

Heat Is Generated at Electrode Points

Reference to Fig. 3 shows that heat is not only generated at point *C* between the sheets, but also at point *B* between the sheets and the electrode. In the welding of those metals which have a resistance several times that of copper, the thermal gradient will take the shape as shown.

This, of course, is the preferred form of the gradient. In the case of metals having less electrical resistance, the points *B* increase in magnitude until, for the condition of welding copper, the three peaks become of equal magnitude. In this case, an attempt to weld is quite likely to result in welding the electrodes to the sheet as well as welding the sheets together, if any weld is made.

When welding mild steel, since this material has a resistance greater than copper, the gradient will take the form as shown in Fig. 3. It is for this reason that so little trouble has been encountered in the welding of the mild-steel alloys. In the case of the alloys having a resistance several times that of mild steel, the heat generated at point *C* is still greater for a given condition of current flow, electrodes, surface condition and pressure, so that in this case too much heat is developed at the desired point. This requires a reduction in voltage drop across the work pieces, which is accomplished by adjusting the heat regulator to a lower heat point.

In the thermal gradient of Fig. 3, only the instantaneous conditions were represented. The actual welding operation, however, requires a time interval, since power required (or heat generated in the weld) is the product of the current through the pieces, times voltage across the pieces, times the time of current application, times suitable factors for heat loss.

Timing Was Left to Discretion of the Operator

Until the advent of motor-driven machines the timing was left to the discretion of the operator, who judged the completion of the weld by the appearance of heat indicated by a change in color of the surface in contact with the electrode. In the desired form of welding, the heat generated by the inner

20th ANNIVERSARY—1916-1936

THE occasion of your 20th anniversary of the founding of "The Welding Engineer" prompts me to send you our congratulations and to express our appreciation as a company and individuals of the splendid work you have done throughout these many years.

As we are one of the pioneer companies in the gas field, going back to 1913, and have watched your progress ever since you started, we can truthfully say that "The Welding Engineer" has always been a real friend in every way to both the users of every kind of welding product and to the manufacturers of such products as well.

Our congratulations and best wishes for your continued success.

—PARKER B. FRANCIS,
President, Puritan Compressed Gas Corp.

* * *

PERMIT me to congratulate the staff and publishers on the successful completion of twenty years of service to the welding industry. During the years of its existence "The Welding Engineer" has seen the industry grow from small beginnings to its present gigantic proportions. "The Welding Engineer" has been a vital force in this growth.

To adequately serve the trade, a magazine must publish all the news of importance and interest to that trade, selected with a high degree of discrimination. Every issue must contain authoritative and informative articles of a technical or semi-technical nature to assist users of the various welding processes in solving their problems. Timely editorials, clearly and concisely expressed, are essential if the publication is to be a factor in maintaining the standards of the industry at a high level. A happy combination of these three elements is what makes "The Welding Engineer" the well-balanced paper that it is.

In a rapidly expanding field it is inevitable that controversial subjects should arise from time to time. It requires courage, fairness, tact and discretion on the part of the editorial staff to cope with such difficult situations. In my opinion, "The Welding Engineer" has always been equal to the occasion.

The valuable service of publishing and from time to time, as conditions require, bringing up to date "The Welding Encyclopedia," is a valuable service rendered by "The Welding Engineer" which I feel should be mentioned at this time. This book certainly contains the most comprehensive data on welding so far compiled in a single publication.

I take this opportunity to thank "The Welding Engineer" on behalf of myself and those associated with me in the welding business and of wishing you many happy returns of the day.

—K. L. HANSEN,
Consulting Engineer,
Harnischfeger Corporation.

surfaces does not reach the outer surfaces in sufficient amount to cause discoloration. This is, however, modified to some extent by the thickness of the piece and the size of the weld.

The above condition will, in general, require short welding intervals. Fast-operating motor-driven machines have been able to make welds excellent in appearance and strength, but the lack of easy adjustment limited to some extent the obtaining of the best results for varying types of materials. This indicated that a separate device for controlling the time of current application was desirable, and resulted in the weld-timing control, of which there are several makes and types available.

Adjustments Readily Made for Heat, Pressure and Time

The spot-welding machine then is provided with three adjustments which may be readily made. These are:

(1) Heat adjustment, obtained in steps by heat regulator.

(2) Pressure adjustment, obtained by adjusting spring, air or hydraulic pressure.

(3) Time adjustment, obtained from observation, length of motor-driven cam-operating pilot switch, or by adjustment of timing control.

In addition to these are adjustments not so easily obtained, such as:

(A) Electrodes—size, shape and material.

(B) Electrode arms — spacing and length.

A knowledge of these adjustments, their limitations and effect on welding conditions, will help in determining whether or not a certain job can be done in a certain machine and also whether or not the welding operation can be materially improved for a given job. To show the effect of these adjustments, it is advisable first to consider them in their general effect on the thermal gradient of Fig. 3, and then discuss the adjustments to be made for different materials and alloys.

The heat adjustment is made by operation of the heat regulator. This regulator changes the ratio of primary to secondary voltage, which for a given condition of work-pieces will produce a change in current. All machines, except perhaps some special-purpose machines, have a range of current adjustment of at least 4 to 1, and some makes have ranges as high as 16 to 1. In general, the low-kva. machines (up to 15 kva.) have a range of 700 to 3500 amperes in the secondary, medium-kva. machines (up to 35 kva.) have a range of 1200 to 7500 amperes, while machines of larger rating or for special purpose may have much higher currents available. In all cases, however, it is advisable to measure the current. This may be done by measuring the primary current and multiplying by the ratio of primary to secondary voltage. Most machines have from eight to sixteen heat points.

Pressure Varied by Spring Adjustment

Pressure adjustment on manually operated machines is made by changing the compression of a spring, located either at the rear of the machine or in the movable head. On low-kva. machines the range of adjustment is generally from 20 to 200 lb. total pressure. For medium-kva. machines this range is, in general, from 50 to 500 lb. total pressure. Large machines have correspondingly higher pressure ranges, but these are modified by the type of welding the machine has been designed to perform. Where the pressure adjustment is not calibrated as is often the case, a pressure meter should be used to determine the actual pressure. The most common form of pressure meter consists of two sealed diaphragms connected to a suitably calibrated pressure gauge. Pressure exerted on the discs by the electrodes (without current) is indicated on the gauge.

The pressure adjustments of motor-driven machines are similar to those of manual machines, but the pressure ranges are somewhat higher.

Air and hydraulic machines have direct-reading pressure indicators, calibrated by multiplying the area of the piston in square inches by the gauge pressure. The pressure adjustment is obtained by a reducing valve and is continuously adjustable throughout the pressure range. The range of pressure for these machines depends, of course, upon the diameter of the cylinder and the line pressure, and may be readily calculated for any machine.

In the case of both manual and motor-driven machines, the pressure is often left at one value and never adjusted because of the inconvenience of making this adjustment. The pressure adjustment is very important, however, and care should be given to this adjustment, in order to obtain the proper value.

Reference to Fig. 3 reveals that the resistance of the surfaces in contact depends upon the pressure forcing the surfaces together, as well as the surface condition and the conductivity of the material. This is because the surface is not smooth enough to have perfect contact. The amount of surface in contact is determined, for a given condition, by the pressure.

Resistance Decreases With Increased Pressure

As the pressure is increased, the resistance decreases, and for a given condition of the work-pieces, this decrease in resistance will require a greater current to develop the same amount of heat in the same time interval. The decrease in resistance will allow more current to flow, but this effect is small compared to the variation in pressure possible. It might appear desirable to decrease the pressure and thus increase the resistance and the heat generated at C. This, however, causes discoloration or deterioration of the outer surfaces. Further, it is necessary to force the pieces together after fusion has taken place, and too low a pressure would not ac-

20th ANNIVERSARY—1916-1936

THE development of fusion welding during the past twenty years has been a jump from the ridiculous to the sublime.

Something over twenty-five years ago at the old Kellogg Plant in Jersey City, we made some of the first fusion-welded pressure vessels and, I believe, welded on the first nozzles that were ever welded on pipe headers. Welding was done using a carbon arc and boiler punchings for filler metal. Most of these products stood up fairly well, except that when a header was dropped a nozzle was liable to break off. At our shops, this method of welding was superseded by hammer welding, which in turn was superseded by fusion welding, using the coated electrode.

The development of the x-ray for examining fusion welds and the issuing of the fusion-welding sections of the ASME Boiler Code brought confidence to the skeptical, and today, modeled on the original ASME Code, we have the API-ASME Code covering welded vessels for the petroleum industry, and regulations for practically every department of the Federal Government with the exception of the Interstate Commerce Commission. The American Bureau of Shipping has approved the regulations of the Bureau of Navigation and Steamboat Inspection of the Department of Commerce. British Lloyds have also approved fusion welding, and I understand that the French, German and Swiss governments are all about to promulgate Codes based on the original ASME Code.

Today the world over, any engineer with experience in fusion-welded pressure vessels recognizes the highest class of such as the equal if not the superior of seamless forged vessels and large-diameter seamless pipe.

I cite the heavy-pressure-vessel industry because this is the industry which I know, but the development of welding in the smaller-pressure-vessel industry, the welding of pipe-lines, the welding of steel structures of all sorts and kinds, has advanced just as fast until now any competent structural engineer must be versed in welding as his predecessor was versed in riveting.

—H. L. R. WHITNEY,
The M. W. Kellogg Company.

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IN MY OPINION, the principal value of "The Welding Engineer" during its twenty years of existence is the confidence with which its readers can feel that it is unnecessary for them to cull by their own efforts the many scattered accounts of welding progress which are found in the literature today. On the contrary, they can depend on finding all that is important selected for them within the covers of one periodical. With best wishes for your continued success.

—GILBERT E. DOAN,
Lehigh University.

complish this, but would result in a porous and weak weld.

It will be evident that there is one point in the pressure range at which best results are obtained. This is particularly true of some of the alloys. In the welding of mild steel, this range is rather broad, which accounts for the satisfactory results being obtained without careful pressure adjustment.

The time adjustment has received more discussion in the last few years than any other adjustment. This has been brought about by the advent and use of timing control units which have been made available by several electrical-control-equipment builders. Without doubt, the judging of a satisfactory weld by the operator is a slow and variable process.

Operation Improved by Motor Drive

In those cases where manually operated machines have been used successfully in fast production, the success of the operation depended upon the skill of the operator in duplicating time intervals. Further, manual machines are limited to low pressures, due to the fatigue of the operators when on fast production. The motor-driven machine is an improvement in that it is possible to obtain higher pressures and a regular time interval in production. However, the inconvenience of obtaining time and pressure adjustment has led to the widespread use of the heat regulator as the only regular adjustment.

The importance of timing control is brought out by a further consideration of the thermal-gradient curve shown in Fig. 3. As the current is allowed to flow for a longer interval the peaks disappear as fusion occurs at *C* and as softening of the surfaces at *B* causes fuller contact. Further, heat is absorbed by the work pieces and electrodes, which also helps to reduce the peaks. The penetration of the weld is determined by the length of the time interval and the rate of absorption of heat by the pieces. It is evident that for a given condition of current, pressure and work-pieces, the penetration of the weld can be controlled by the time of current application. It is possible to weld so that when the work is removed from the machine the outside surfaces are cold, and heat is felt only after an interval sufficient for it to travel to these surfaces.

Electrodes Should be Selected for the Specific Job

The electrodes, another important factor, should be adjusted or selected for the individual job. Electrodes of various materials and shapes are available, some being hard and of various copper alloys. The preferred electrode would be hard and have a resistance less than copper. At present, all hard alloys have a resistance greater than copper, which means that more heat is generated between the surface and the electrode than when copper electrodes are used. The shapes available are, of course, infinite, and the effect of the shape will be discussed in a later article. The electrodes, however, should be chosen for the job, and it is possible to effect in some cases great improvement in welds by use of proper electrodes.

In most shops, the operator is permitted to dress the electrodes with a coarse file. Few men are experts with a file, and the practice of operators dressing electrodes in place is probably the greatest single cause of excessive surface indentation and burning. This may be eliminated by using electrodes which have been properly dressed in a lathe, and replacing when contact surfaces show signs of wear.

The physical position of the electric circuit of the secondary has some adjustment. In all machines the electrode arms may be adjusted for space. The lower arm is usually raised or lowered to accommodate various sizes and shapes of work-pieces. In some machines the length of the electrode arms may also be adjusted. The amount of open space in the secondary circuit is relative to the secondary current the machine will develop. In most designs of machines the maximum power is obtained when the electrode arms are shortest and are placed the closest practicable. This adjustment is not of great iimportance, unless it is possible to attain this condition and the machine is operating at the highest heat-regulator point, in which case the increase in power may permit successful operation.

Secondary Circuit Should Be Kept Clean of Oil and Dirt

It is important that all parts of the secondary circuit be in intimate contact and all bolts tight. A periodical cleaning of all surfaces forming joints in this circuit is needed, since oil and dirt enter between surfaces and increase contact resistance. In some cases the current available in the secondary has been doubled by cleaning surfaces which had not been cleaned in years.

In the discussion to follow, methods of welding various metals and alloys will be described with particular reference to the application of these welding methods to machines of the type now in general use.

London Firm Seeks New Welding Processes

Welding is coming into increasingly greater use throughout Great Britain, and with the rapid widening of industrial activity in all branches an especial interest is demonstrated in the latest and most satisfactory methods.

Barimar, Ltd. of 14-18 Lamb's Conduit St., London, W. C. 1, are desirous of communicating with engineers in this country who have developed or are in possession of new processes which they plan to introduce to British markets.

Get "H. O. T." on Welding

By H. O. T. RIDLON

The Safety Valve Works

There seems to be a certain glorious uncertainty about law. Perhaps, it's not the law after all. Perhaps it's the men that make the laws, and yet it might be only the men that should obey those laws. But no doubt it is a combination of all these things that makes the uncertainty so very positive. First the NRA went the way of all flesh, more recently the AAA followed. And soon more of the New Deal's noble experiments will follow. Many of the devoted followers of the New Deal feel that nine old men have spoiled their chances for an endless Utopia. It seems to me, if my memory serves me correctly, that when a man becomes president, he swears to uphold and defend the Constitution of the United States. It seems hardly fitting or proper that any one citizen or president has the right to change the laws of the land to suit his pleasure, or the pleasure of his admirers. The successful head of a business consults his attorneys before he attempts to do something that there may be any doubt about his being within the law. He does not go ahead and then try to change the law after he has gotten into hot water. He knows where he is going before he starts. The governing bodies of our government are not void of legal talent to consult with before they start on some wild idea. Those nine fine citizens that make up the Supreme Court of the United States are not nine doddering old fools, as some would lead us to believe. The Supreme Court of the United States is a safety valve, just in case some unthinking engineer isn't on to his job and through his folly allows this government of ours to blow up and be ruined beyond repair.

Let us keep the safety valve always in working order!

I wonder how many of these 18,000,000 people in the United States that are or almost are eligible for the old-age pension are used to getting at any period of their lives $200 per month—to say nothing of spending it on themselves. You know what I'm talking about—Mr. Townsend's plan for recovery. I wonder how many mothers and fathers in this land of ours would expect their son or daughter to give them half of what they earn. I understand that this plan would consume about half the national income. And this country is ours, yours and mine. I wonder what would become of these great fraternal homes and private charities that take care of these old folks so well. I cannot help but wonder if someone is not trying to build a wonderful sucker list. You know they must spend the two hundred every month as they get it. It just doesn't make good sense, that's all.

* * *

Pass in Review

For twenty years, that's a very long time, this paper has been bringing news of things and people of the industry to its readers. Would that I were able to pay proper tribute to its owners and editors, past and present, for the grand job they have done in helping all of us. Come what may, I sincerely hope that they carry on in such a worthy and helpful cause.

Much has happened these twenty years. I would like to review them all for you. Bring them on parade, as it were, before your eyes. But in reviewing the past twenty months, I can but high spot some of the things I remember and that have impressed me most. You will find much, perhaps, of interest to you in reading these old issues.

August, 1934—The second year of the Century of Progress was in full swing in Chicago. It was truly a great show, and did we have visitors this month, or did we have visitors.

September, 1934—A dandy story about "Cast Iron Arc-Welding of Wobbler Ends of Strip-Mill Rolls." That's one that is worth reading again.

A vertical d.c. arc welder is announced.

October, 1934—National Metal Congress held in New York City. The oxy-acetylene equipment manufacturers got a bad break. Almost no demonstration of their equipment, because of fire department ruling.

An interesting article in this month's issue about the all-welded construction of the new Milwaukee Railway coaches.

November, 1934—International Acetylene Association convention held in Pittsburgh. Many very fine papers.

"The Picks" (Dr. and Mrs. Jean Piccard) take a ride to the stratosphere in an all-welded gondola. I get rumors that they are thinking about taking another one this coming year, and then shooting for twenty miles straight up.

Spent Nov. 11th in Pittsburgh and found out who won the war.

December, 1934—Mildred Kinkead, the very clever wife of Bob Kinkead, busts into print with her new column, and ever since we've been learning what the women folks think of us.

An interesting story this month about A.C. vs. D.C. Welding. I'd like to see more of such articles.

The thought for the month: No depression ever killed an opportunity.

January, 1935—Some of you welding-shop owners might re-read this month's column of mine "So you won't talk, eh?" and profit thereby. I've got a few reprints of it, that are yours for the asking.

February, 1935—Riddervold Jensen contributes the first of two very fine articles on Shrinkage Strains and Stresses Caused by Welding. Sure, this is deep stuff, but it won't hurt any of us to try to get it through our heads.

March, 1935—Jensen gives us the second one of his fine articles.

A dandy line of chatter about one of my pet peeves, "Use Care in Selecting Your Welding Cable." More thought should be given to little details like that.

April, 1935—And here's one no welder can pass over lightly and should be read again, "Preparation for Welding and Cutting Certain Types of Containers which have held Combustibles."

Some good information about Gas Welding and Silver Soldering Monel Metal and Nickel. That is something all welders should get wised up on if they intend to keep up with the times.

June, 1935—A fine article for welding-shop owners and would-be owners to read, study and inwardly digest, entitled, "Good Location the First Essential of a Successful Welding Shop."

July, 1935—They tell us the story of dropping the Sky-Ride tower. That's a real romance of our industry.

An article on "Positioning Steel Assemblies for Welding."

August, 1935—A swell article on "Welding the Stainless Steels." Might I add that the type of oxyacetylene flame and regulation of the gases are also mighty important.

Mildred Kinkead comes out in the open and lets us know who the Welding Engineer's wife is.

Read "Experiences With A.C. Welding," if you haven't done it.

September, 1935—"The Banker Takes a New Slant on Credit" is really worth reading.

October, 1935—National Metal Exposition and American Welding Society hold forth in Chicago. Swell show; sorry for you gents that missed it.

November, 1935—An interesting article on Flame Cutting and Its Application, is worth a lot of study by all of us.

The International Acetylene Association convention in Cleveland. And what a grand gathering of the clan it was.

December, 1935—Something really new announced in arc welders.

* * *

The thought for the month: This year let us remember to pause, and *think!*

What's New in Equipment and Supplies

Throatless Shears for Steel and Stainless Steel

"Beverly" throatless hand-lever shears, for both straight and irregular cutting, are being offered by Tanner and Company, Indianapolis, Ind., to the welder and sheet-metal worker.

These shears are made in two sizes—No. 314, for shearing 14-gauge mild steel or 16-gauge stainless steel; and No. 310, having capacity for shearing 10-gauge mild steel or 14-gauge stainless steel.

The frame of both of these shears is made of high-grade chrome-nickel steel for maximum strength combined with light weight. The No. 314 Shear weighs only 16½ lb. and the No. 310 Shear 33 lb. Either makes a most useful tool that can be readily carried from one job to another and clamped on a bench for instant service.

Starting the cut from the edge of the sheet, this throatless frame permits shearing of any length. The special design of the frame makes it practicable to turn the metal while cutting, allowing any shape to be cut on the lighter materials without distortion. It is also well adapted for notching work. It will cut outside curves up to the full rated capacity and inside curves on lighter material, the capacity depending somewhat on the minimum radius to be sheared.

The top blade is actuated through a rack and pinion and a convenient-length hand lever, giving great power with little effort.

The blades are made from a high-grade tool steel, properly hardened, adjustment provided for wear, and the blades are interchangeable. The cutting edges are straight, with the top and bottom surfaces curved for greater shear and clearance when cutting intricate shapes. For cutting stainless steel special steel blades can be furnished at an extra charge.

The smooth cutting edges of the blades produce a clean-cut sheared edge free from knurl or other marks, eliminating the necessity of filing or touching up—so objectionable in many lines of manufacture.

"Beverly" Throatless Shear.

Grid Glow Tube With Built-In Time Delay

Important advances in gaseous discharge tube design has been made in the new Westinghouse KU-676 tube, adaptable to weld-timing control and other applications. This tube has two new features—a built-in time delay for protection of the cathode when starting the tube, and a new cathode design. This results in a high ratio of crest to average current rating, which is especially important for such applications as Ignitron control, welding timers, 6-phase rectification, and the like.

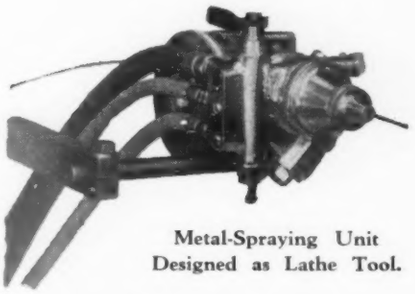
The directly heated portion of the cathode is an edge-wound helix, closely surrounded by an indirectly heated portion of perforated metal coated only on the inside surface. The discharge is thus forced to pass through the perforations in the screen and then outward through the annular space between the screen and the first radiation shield. This construction has been developed with the object of electrostatically shielding the active surfaces of the cathode to such an extent that they are not subject to high field strengths and are also protected from excessive positive-ion bombardment. These structural features thus lead to a more nearly "fool-proof" cathode with much longer life expectancy. In addition an extremely efficient cathode results.

The current rating of the KU-676 tube is 6.4 amperes average and 75 amperes crest, while the cathode heating energy required is only 55 watts. The tube is made by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Announces "Mogul," New Metal-Spraying Unit

A new metal-spraying unit known as "Mogul," is being announced by the Metallizing Co. of America. Possessing the same general characteristics as the "Metallizer," this new unit has certain features that make it particularly adaptable to certain classes of severe service.

Primarily the new "gun" was intended for mounting in the tool post of a lathe



Metal-Spraying Unit Designed as Lathe Tool.

to be used for machine-element coating, and for that reason no particular effort was made in the design to keep the weight at a minimum, but, despite that, it is not too heavy to be used as a portable tool and is available for that purpose as well as a lathe tool.

One feature worthy of note is that the wire-feed mechanism and gas head, while attached to each other, are in reality separate units. This departure from the conventional design reduces the replacement cost in case either assembly is damaged, and furthermore permits a suitable combination of metals to be used for the construction of these parts.

The wire-feed unit is self-contained; all the worms and gear-shafts are mounted on annular ball bearings and these assemblies run in a bath of fluid grease and are completely enclosed in a dust-proof case. The use of annular bearings insures permanent alignment of the worms and gears. The turbine has more power than is actually needed and is said to run at a slower speed than in other equipment of this type, and because of its proportions it will maintain a steady flow of power without continual adjustment.

The gas head is a bronze casting and the simultaneous-control valve is of hard bronze. Splendid wearing qualities are assured through the use of this combination of materials, and the valve, it is claimed, will need very little attention. The gas and oxygen mixing is done in a metering tube, which is so designed that there is little likelihood of flash-back down the oxygen hose. A hardened-steel wire-guide tube is incorporated in the assembly so as to reduce wire wear in the parts of the front end.

The complete separation of the gas head and wire-feed mechanism is an insurance against combustible-gas mixtures working back into the enclosed gear case through gas-mixing channels drilled in the gear case proper.

The thought behind the "Mogul" has been to produce a metal-spray unit that would stand up under severe service, a unit that would "stay put" and continue to perform without interruption—in other words, a production tool.

The "Mogul" gun does not replace the "Metallizer" gun but is a "high-power" hand-built production tool. It is available in two models: Model A, for the

production spraying of steels, monel, and nickel; and Model B, for the production spraying of aluminum, bronzes, copper, and brass.

Machine for Grinding Farm-Equipment Discs

The "Rite Way" disc grinder is said to result in even, accurate sharpening of any size of farm disc, and the adjustments are arranged so the operator will not burn the disc, says the New Process Plow Welding Co., Perry, Iowa, manufacturers of this new device. Features include an adjustment to bring the disc table to the stone, a lever to adjust the pressure, a rest block which is permanently left on the emery stand, and a grinder which can be lifted out of the way when not in use. The unit weighs 55 lb.

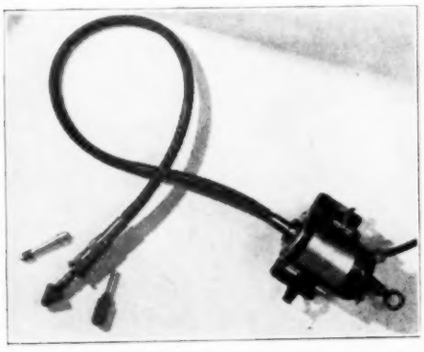
New Line of Presses and Air Compressors

A complete line of hydraulic and screw presses and air compressers has been announced by the Wright Manufacturing Division of the American Chain Co., Inc., York, Pa. These new products will be distributed exclusively through the industrial and mill supply accounts. The new line of presses includes 25, 40 and 60 ton hydraulic presses and 25 and 35 ton screw presses. The compressor line includes both single- and double-stage units in permanent and portable styles.

High-Speed Grinding Tool With Flexible Shaft

Though designed primarily for high-speed grinding, the Jarvis "Speedwitch" can be used equally well on welds, steel dies and castings. Such additional tools as sanding drum, and hard-felt polishing buff of small diameter, increase its range to include polishing, buffing and sanding operations.

The "Speedwitch" is driven by a 1/3-hp. ball-bearing heavy-duty universal motor, 110 volts, complete with built-in switch and cord. The motor is mounted in a combination bench and overhead-suspension base equipped with a hand piece holder. The flexible shaft is ¼ in. by 42 in. long, with rubber-reinforced casing, and has two protection springs on each end of the casing.



Tool for Grinding Welds, Dies and Castings.

Further details regarding this new tool can be obtained from the manufacturer, The Chas. L. Jarvis Co., Gildersleeve, Conn.

Power Take-Off for Welder Drive

A power take-off, which makes a truck a power plant as well as a means of transportation, has been developed by The Hercules Steel Products Co., Galion, Ohio, in conjunction with The Lincoln Electric Co., Cleveland, Ohio. It is made in various models to operate as a direct drive or from the side. The unit is adaptable to all makes and models of trucks. It does not affect the road speed or power of the truck, since it simply replaces a portion of the truck's drive shaft.

Power supplied by any leading make of 1½-ton truck is sufficient to drive either a 200-ampere or a 300-ampere welding generator. The power take-off can be controlled from the driver's seat by a single lever. While welding, the speed of the truck motor is controlled by a flyball type of mechanical governor.

Made of chrome-nickel alloy steel, this power take-off weighs 100 lb. fully installed. All bearings are anti-friction ball and roller type. The unit is guaranteed to transmit 120 brake hp. at 2800 r.p.m. and 220-ft.-lb. torque.

Trade Literature

A booklet, most attractively made up to present the beauty, popularity and enduring radiance of stainless steel, including illustrations of many stainless-steel articles, is available for distribution to users and prospective users of this metal. A copy is obtainable by writing Joseph T. Ryerson & Son, Inc., Lock Box U, Chicago, Ill., on a business letterhead, and explaining just what the company's interest is in stainless steel.

A catalog of welding supplies, including rods, electrodes, solver solders, brazing alloys, electrode holders, etc., has been issued by the Steel Sales Corp., 129 S. Jefferson St., Chicago, Ill. The purposes and uses of the various rods and electrodes are described, and practical information is given on gas and arc welding theory and technique.

"Amcoweld" arc-welding accessories are listed in a catalog recently issued by the Smith Welding Equipment Eastern Corp., Roslyn, Pa. These include electrode holders, hand shields, helmets, lenses, cable, carbon electrodes and plates, wire brushes, gloves, and metallic filler.

The China Clipper employed welded chrome-moly steel in many ways, according to the December "Moly Matrix," which illustrates and describes some of these uses. Copies may be obtained from the Climax Molybdenum Co., 500 Fifth Ave., New York, N. Y.

"New Process" plow-reclaiming units are described and listed in a new 28-page catalog, which also lists welding rods and accessories. Copies can be obtained from the New Process Plow Welding Co., Perry, Iowa.

"Manganal" bare welding electrodes for manganese steel are described and advantages of the bare nickel-manganese electrode for d.c. welding are brought out in a folder issued by the Stulz-Sickles Co., 91 N. J. Railroad Ave., Newark, N. J.

The metal, tantalum, is discussed at length in a 48-page booklet issued by the Fansteel Metallurgical Corp., North Chicago, Ill. Its physical properties, applications and fabrication (by welding and other methods) are described.

The welding of aluminum by both the electric-arc and oxyacetylene processes is explained in a booklet prepared by Woolridge Aluminum Welding Products, Glastonbury, Conn., for distribution to the trade.

Spot welders of both portable and stationary types are illustrated and described in a loose-leaf catalog issued by the Fassler Welding Machine Co., 424 Stormfeltz-Loveley Building, Detroit, Mich.

The "Donganare" a.c. welding unit is illustrated and described in a folder issued by the Dongan Electric Manufacturing Co., 2987 Franklin St., Detroit, Mich. Many applications are listed.

Development of the metal-spray process is touched upon, and some of its possibilities indicated, in a folder published by the Metalspray Co., Inc., 113 Llewellyn St., Los Angeles, Calif.

A discussion of design of welded girders for tier buildings is continued in Plate 53, Studies in Structural Arc Welding, recently issued by The Lincoln Electric Co., Cleveland, Ohio.

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WELDING
BRAZING
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EXPERTS ON
PIPE LINE WELDING
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1244 MASSACHUSETTS AVE.
BOSTON, MASS. October 25, 1935
THE AMERICAN BRASS CO.
WATERBURY, CONN.
We have been using Tobin Bronze about twelve years and when this important job came along which required the finest workmanship and materials, we did not hesitate to use your product knowing that it would satisfy all requirements.
Sam Wolk
Manager

Mr. Sam Wolk, manager of Star Welding Company, Boston, who used Tobin Bronze for all brazing done in the all-welded air-conditioning system in Filene's Department Store, Boston, Mass.

TOBIN BRONZE

"met all requirements"

Mr. Sam Wolk knows from almost twelve years of actual welding experience that Tobin Bronze is a *better* welding rod. He declares that it was "a valuable aid in the successful completion" of the job illustrated above.

Good welders throughout the country know that the use of good welding rod pays them as well as their customers. That is why thousands of them use the original low melting point bronze rod, trademarked "Tobin Bronze Reg. U. S. Pat. Off." ...an exclusive product of The American Brass Company. They will tell you, "Don't gamble on an unproved rod."

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THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut

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ANACONDA WELDING RODS

Commercial News

Machinery & Welder Corp. Holds Sales Meeting

The Machinery & Welder Corp. held a sales meeting of all their district managers and officers in St. Louis, Mo., on Dec. 26th to 28th. The meeting ended with a banquet at the Coronado Hotel. The first day, the 26th, was spent at the

Machinery & Welder Staff's Picture Taken at Sales Meeting.
(Left to right—Back row: C. J. McEnery, H. C. Kelsey, A. W. Roth, L. Walker. Front row: G. F. Meyer, F. P. Kohlbry, R. L. Kohlbry.)

factory of the Modern Engineering Co., where the accompanying group picture was made. The Machinery & Welder Corp. have enjoyed a healthy growth, and during the past year greatly expanded their field and established several new branch offices.

Commercial Gas Company to Hold Welding Confabs

A series of welding shows will be given by the Commercial Gas Co., of Minneapolis, Minn., in the states of Minnesota and both Dakotas, during the months of January, February and March. The dates and the locations are announced as follows:

Duluth, Minn., S. & S. Auto Parts Co., Jan. 23rd to 25th. Fargo, N. Dak., Fargo Motor Supply Co., Jan. 29th to 31st. Minot, N. Dak., Motor Service Co., Feb. 3rd and 4th. Bismarck, N. Dak., Quanrud, Brink & Reibold, Feb. 6th to 8th. Aberdeen, S. Dak., Reinhard Brothers Co., Feb. 11th to 13th. Mitchell, S. Dak., General Motor Equipment Co., Feb. 17th and 18th. Sioux Falls, S. Dak., L. & L. Motor Supply Co., Feb. 20th to 22nd. Minneapolis, Minn., Williams Hardware Co., Mar. 4th to 7th.

Aside from the showing and demonstrating of equipment, no effort will be made to commercialize on these shows, as they are intended to be educational gatherings, where the blacksmith, welder and garage man can talk over their welding problems. Hence, the name "Welding Confab" has been adopted as describing these shows.

The equipment carried will include two d.c. and two a.c. arc welders and ten gas-welding outfits—all operated by 12 expert instructors. Other miscellaneous equipment such as a large assortment of scrap iron, including cylinder heads, cylinder blocks, shafts, plow shares, manganese-steel parts, white metal, aluminum, stainless steel and various agricultural implements, will be carried for demonstration purposes. A tensile-strength pulling machine and a microscope which magnifies 50 diameters, will also be part of the equipment.

In order to properly control registrations, merchandise prizes totaling over $500 in value will be given away. There will be 10 prizes offered at each show, ranging in value from $1 up to $20. With the exception of the Minneapolis show, the jobber handling the Commercial Gas Co. products will give a free lunch to all visitors.

Very little time will be devoted to lectures or papers, but visitors can spend their time watching practical demonstrations and practicing welding for themselves under the supervision of an instructor. Several interesting motion-picture films will be shown.

This series of shows is the outgrowth of the successful welding shows that the Commercial Gas Co. has conducted in Minneapolis each year for the past five years. Last year, the company also conducted 2- and 3-day shows at various points in North and South Dakota. The total individual registrations for all their shows last year was over 3800, the registration for the Minneapolis show alone being 1587.

Truck Built to Handle Equipment for Welding Shows.

The Baltimore Division and Baltimore Tube Co. Division of Revere Copper and Brass Incorporated have been consolidated and hereafter will operate as the Baltimore Division. Sales offices are at 1301 Wicomico St., Baltimore, Md., which is the address of the former Baltimore Tube Co. Branch offices of this division are located in Philadelphia, Atlanta, and New Orleans. R. S. Stringer is vice-president of Revere's Baltimore Division, and R. H. Hodges sales manager.

W. V. Emery, former Detroit representative of the Harnischfeger Sales Corp., has been transferred to the head office of the company in Milwaukee, and his place has been taken by F. A. Liebich, formerly of the Chicago office. In addition to this change, G. J. Friebel, formerly with the Milwaukee office, has been appointed as Detroit representative, working under Liebich. Mr. Friebel reports an exceptionally good pickup in sales to manufacturers of automobiles and automotive supplies.

R. R. Davis, formerly assistant manager of the advertising department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has succeeded Ralph Leavenworth, who resigned as manager as of Jan. 1st, according to an announcement by N. G. Symonds, vice-president. Mr. Leavenworth has joined Fuller & Smith & Ross, Cleveland advertising agency, which handles the Westinghouse account.

A class in oxyacetylene welding and cutting to be held each Saturday afternoon, from 1:30 to 5:30, beginning Jan. 18th and running to April 25th, is being instituted by the Wayne Welding & Supply Co., 517 E. Wayne St., Fort Wayne, Ind., for the benefit of the company's customers. The project will be operated on a non-profit basis, and the course will cover 60 to 80 hours.

R. L. Mead has been appointed manager of the Chicago office of the Harnischfeger Corp., located at 20 N. Wacker Drive. Mr. Mead has been connected with the Industrial Brownhoist

Co., The Ohio Locomotive Crane Co., and the McMyler Interstate Co., and more recently he was district sales manager of the Link Belt Co.

The Quickwork Co. have moved from St. Marys, Ohio, into their new plant at 900 N. Spaulding Ave., Chicago, Ill. In addition to their lines of rotary shears, power hammers and other metal-working machinery, they are now building welded steel press frames, welded steel columns for power hammers, and other welded steel assemblies.

William W. Miller, manager of the General Electric Co.'s industrial department, died on Dec. 22nd, following an operation for a ruptured appendix. His long career with the company began when he was only 12 years of age. J. E. Hume, assistant manager of the department, succeeds to the position held by Mr. Miller.

George H. Reid has been appointed industrial department manager of the General Electric Co.'s New York district, succeeding Fred S. Hartman, who reitred at the close of the year. Mr. Hartman's services will still be available to the company in an advisory capacity.

The Hart Welding Supply Co., with headquarters at 411 W. California Ave., Oklahoma City, Okla., and branches in Borger, Houston and Pampa, Texas, and Rodessa, La., has been appointed distributor for Murex welding electrodes throughout Oklahoma, Texas, Western Louisiana and South-Central Kansas.

L. R. Berkeley, 3229 Fairmont Blvd., Cleveland, Ohio, has been appointed Cleveland representative for Ameircan Electric Fusion Corp., of Chicago; Sight Feed Generator Co., of Richmond, Ind.; Universal Power Corp., of Cleveland, Ohio; and Wilco Electric Welding Machine Co., of Kansas City, Kan.

As a result of an automobile accident on the evening of Nov. 27th, C. B. Herrick, of the Kansas City, Mo., office of The Lincoln Electric Co., has been confined to the hospital with a broken leg, three broken ribs, and cuts and bruises.

The Wayne Welding & Supply Co, Inc., Fort Wayne, Ind., have been appointed distributors of the new Westinghouse FlexArc welder for the Fort Wayne district in northern Indiana.

Notes From the Field

A new type of trailer is being promoted by The Dayton Trailer Co., Dayton, Ohio. It is deluxe to the nth degree, and is a welded frame job, the welding being done by Everett Jones, R. R. 2, Dayton. The chassis frame, and also the body frame, are welded for greater strength. The lines of modern automobile construction are followed as close as possible. All metal-to-metal junctions in the job are welded rather than bolted. While some wooden sheathing is employed, welded metal is used wherever possible without building up too great an overall weight.

The McClintic-Marshall Corp., of Pittsburgh, Pa., will hereafter be operated under the name of the Bethlehem Steel Co., the former having functioned as a subsidiary of the latter during the past few years. The Bethlehem Steel Co. maintains large barge yards and marine ways on the Ohio River at Leetsdale, Pa., and is one of the foremost erectors of welded construction in the United States. J. Milnor Roberts, sales contract engineer for the company, is an ardent advocate of welded construction and reports a noticeable trend toward all types of welding.

Disaster struck the Sumner County Engineering Department, Wellington, Kan., when their modern shop and stockroom burned to the ground recently. Gasoline leakage was determined as the cause of the fire. The first equipment to be replaced was electric welders and acetylene torches to be used in rebuilding the plant. A new shop building is to be built at once and will be of fireproof construction. All steel support members are to be of arc-welded design. R. S. Kirk is county engineer, and W. H. McGlade is shop superintendent.

The Kansas State Highway Commission recently completed equipping all of their division shops with arc-welding equipment. All machines purchased were of the motor-generator type, with extended shaft for coupling gasoline-engine power for use in field service. All machines, with one exception, are of the 40-volt type, 300-ampere size. Equipment maintenance will be the big job for the new welders. However, the state has recently gone into arc-welded design on some of its bridges, and especially in bridge repair and reinforcing.

The hydraulic pressure line for a passenger elevator in a large Dayton, Ohio, department store, broke one night recently, and at 2 o'clock that morning Gene O'Neil, proprietor of The New Ideal Welding Co., 334 S. Main St.,

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WELDING ROD

Ryerson Engineers have developed a series of rods that are outstanding for quality production. They are continually checking, testing, and improving—to develop rods that will do specific types of work, faster and better.

Bring your welding rod problem to Ryerson. Let our engineers work with you. You can be sure of finding the right rod for each particular class of work. We will also gladly furnish samples for test. Address the nearest Ryerson plant.

23 Types of Rods in Stock

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Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
Ryerson Shielded Arc Type No. 217
Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Hyerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

Write for Bulletin on Rods and Accessories

JOSEPH T. RYERSON & SON, Inc.

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo
Boston, Philadelphia, Jersey City.

Dayton, got a call to repair it so the elevator could be operated when the store opened that morning. The line carried 110-lb. hydraulic pressure. Mr. O'Neil put a crew on the job and had the pipe repaired and the elevator ready for operation by 7:30 that morning.

Barge yards in the Pittsburgh district are in receipt of an inquiry from John F. Flood, manager of river operations for the Pittsburgh Coal Co., for the construction of ten standard coal barges with a capacity of 900 tons each. Prices are being asked for both welded and riveted construction, but in well-informed circles it is understood that the company leans toward the welded type. These new coal carriers will be 175 ft. long, 26 ft. wide and 11 ft. deep and will require approximately 1,500 tons of steel plates and shapes.

A contract to construct a petroleum barge for the Ashland Refining Co., of Ashland, Ky., has been awarded the Marietta Manufacturing Co., of Point Pleasant, W. Va. This is understood to be the first welded construction to be turned out by the Marietta company. The new barge, which will be equipped with individually welded tanks for the carriage of natural gasoline in the river trade, will be 140 ft. long, by 26 ft. wide, by 11 ft. deep. The order is said to involve an expenditure of approximately $14,000.

Jack Barrington, proprietor of the Barrington Welding Works, 436 Narbonne St., Torrance, Calif., has just completed the erection of a new shop building at 23100 Narbonne St., and is moving his equipment into the new quarters. New lathes and grinders, together with the added working space in the new building, add much to the efficiency and facilities of the shop. Mr. Barrington specializes in the hard-facing and grinding of expeller parts for vegetable-oil plants.

The Dayton Pump Co., Dayton, Ohio, feels that better times must be here for the petroleum industry. Since this company furnishes a good many tanks and pumps for gasoline stations, they should know. The sale of their welded 1000-gallon tanks, and larger, have increased, to the detriment of the sale of 500-gallon tanks.

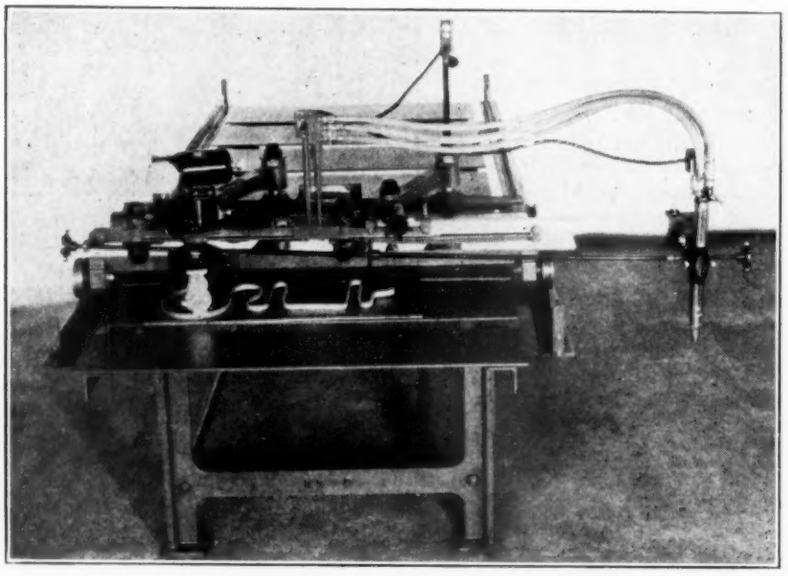
Coupled joints are to make way for welded joints in 10 miles of a 10-in. pipeline of the Kansas Osage Gas Co., in northern Oklahoma. The line, which extends from Gray Horse to Burbank, Okla., was coupled when laid several years ago, but will be taken up in the near future, cleaned, welded by the arc process, and relaid in the same ditch. This work has been awarded by contract to the J. H. McCarthy Co., contractors of Tulsa, Okla.

A new plant requiring a great deal of welding in its construction is to be built in the Wilmington, Calif., harbor district by Spencer, Kellogg & Sons, Inc., refiners of linseed and vegetable oils. The plant, which will be the largest of its kind west of the Mississippi River, will be erected on Cerritos Channel abutting on the west side of Henry Ford Ave.

Jas. L. Phillips, formerly associated with the Kelly Boiler & Welding Works at 530 Mission Rd., Los Angeles, Calif., has opened a welding and boiler shop at 600 N. Mission Rd., to be known as the Mission Boiler Works. Operation of the Kelly Boiler & Welding Works has been discontinued.

The Kansas City Boiler Works, conducting a welding department, have leased for five years a garage building at 506 Campbell St., Kansas City, Mo. Their plant will be removed from the old location, 605 West 5th St. John Shamrock is owner and manager.

C. A. Jones, Beavertown, Ohio, close to Dayton, reports an unusual activity among those who devote themselves t



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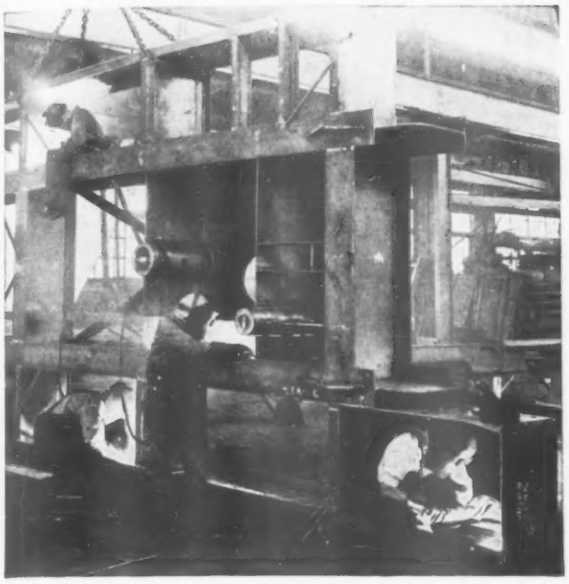
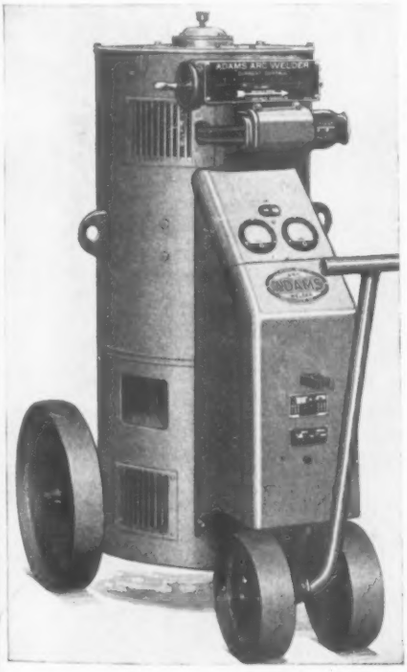


● This swing frame for 40,000 lb. capacity crane could not be normalized but had to be built to withstand heavy shock stresses. Orton Crane & Shovel Company, the manufacturers, solved the problem by using Adams Anneal-Craft Electrodes, which produce an annealing action that reduces locked-up stresses.



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busting up their fenders. He says he has had more fenders to weld during the past two months than in any previous four months in his memory.

The Federal Motorship Corp., of Buffalo, N. Y., are taking bids on two all-welded, self-propelled tankers for use in transportation service in the Erie Canal. These new tankers will be 295 ft. long, 43 ft. wide and approximately 15 ft. deep.

What is reputed to be the heaviest all-welded crane ever built has been in construction by The Cleveland Crane & Engineering Co., Wickliffe, Ohio. Each girder for this crane is 100 ft. long, 8½ ft. high, and weighs 37 tons.

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